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EDITORIAL

During the first World War Dr. Aleš Hrdlička launched the American Journal of Physical Anthropology; now during the second World War a new editor begins the first New Series of the Journal. If, as in the first instance, war can be said to encourage anthropological progress, then it should be an auspicious time to make this change.

Looking back over the 29 volumes of the Journal that have appeared since 1918, Doctor Hrdlička's foresight and courage in initiating singlehandedly a publication in such an undeveloped field as physical anthropology, and especially during a world crisis, seem monumental. Not many visualized the vast materials waiting to be studied or realized the need for a medium in which to record the work waiting to be done. Few even have appreciated the labor involved in those first issues; the labor of soliciting manuscripts, of editing and reviewing, of finding publishers, of keeping track of subscriptions, and of securing financial support.

In 1927 when all this burden, except the editorial supervision and reviewing, was shifted to the capable hands of The Wistar Institute, Doctor Hrdlička's energies were freed. Immediately he set to work to organize American physical anthropologists into an association both for their own benefit and in support of the Journal. Hence, in 1930, the American Association of Physical Anthropologists held its first annual meeting and named the Journal as its organ.

In order to carry these events to their logical conclusion, Doctor Hrdlička volunteered in 1941 to relinquish the editorship of the Journal and to pave the way for ultimate editorial supervision by the Association. The details of this arrangement, which both the Association and The Wistar Institute were pleased to accept, have been published in the proceedings of the Association (this Journal, vol. 29, pp. 313–315). The present number further signalizes this agreement.

AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY, VOL. 1, N. S., NO. 1
MARCH, 1943

It is a pleasure now to report that Doctor Hrdlička is actively carrying on his research, although retired also from the curatorship of the Division of Physical Anthropology in the U. S. National Museum. His continuing association with the Journal in the capacity of Honorary Editor is a source of pride to the Association and of needed counsel and encouragement to the new Editor. At this time the Association, through its editorial board, takes this opportunity of extending its greetings to Doctor Hrdlička on his seventy-fourth birthday, which happily coincides with the publication date of this number.

When the Journal was founded, Doctor Hrdlička was one of the few full-time physical anthropologists in this country. Already he had established certain procedures in anthropometry which are reflected in the publications of others during that period. Naturally, the Journal gave him further opportunity to mould the trends in this field. Characteristically, however, the format of the Journal, as established in the first issue, was maintained for 25 years.

No one will deny that a directive force such as an editor can exert is needed in a developing science. It is certain that unsound and ill-considered work in physical anthropology in America was thus discouraged. However, different schools of thought have arisen in this country during this period and some of them have received scant recognition in the Journal. This situation has been generally accepted because the physical anthropologists had no control over the Journal or its editorial policy.

The new Editor is aware of a triple responsibility: To Doctor Hrdlička, who established the Journal; to the Association, of which it is the organ; and to The Wistar Institute, its publisher. Doctor Hrdlička looks to the new Editor to maintain the standard that he set for the Journal; the Association, judging from personal conversations, wishes certain

liberalizing changes; The Wistar has indicated graciously that it will stand by the Editor in matters of policy.

The Editor feels that a high standard must be maintained. Just what constitutes this standard is the matter at issue. In deciding this point he believes that he must rely upon the advice of the editorial board and upon his own good judgment. This board, he hopes, will not exist in name only, but will play a definite role in policy formation and in other ways.

This first number of the New Series contains no revolutionary changes in format or type of article. The format has always been satisfactory and all that was needed was to bring it fully into line with the established Wistar style. This is desirable for reasons of economy in printing. The articles appearing in the Journal, on the other hand, depend on the contributors and can vary only as the subject matter of the manuscripts vary. The Editor will welcome original articles in all phases of physical anthropology. The fact that in the past and even in this number the subject matter leans heavily toward craniometry, the special interest of the Editors, is no reason why the Journal is not the proper place for articles in applied physical anthropology and other progressive subjects, as well as general articles in the field. The new Editor will do all in his power to diversify the content.

The only notable departure from past practices in this number of the New Series is the use of full critical reviews by persons deemed qualified. Unfortunately, at this time reviewable works are scarce and many reviewers are not available. However, the Editor will encourage reviews of this nature, as well as correspondence on controversial subjects. Such expressions of opinion, provided they are honest and presented in a dignified manner, give spice to a publication.

It will be observed that this number is devoted largely to material on Latin America. The Editor has solicited most

of these contributions in order to place them on record so that the data contained therein may be included in the forthcoming "Handbook of the Indians of South America" to be published by the Bureau of American Ethnology. Also, he has hopes that through this means both the Journal and the Association may arouse greater interest in our colleagues to the South. From the historical as well as the biological standpoints South America presents many problems in physical anthropology that are comparable and related to those confronting us in North America. It will be to our mutual benefit, therefore, to become better acquainted.

STATURE OF SOUTH AMERICAN INDIANS

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TWO FIGURES

In an article on the Maya Indians of Yucatan the writer ('32) summarized the existing data dealing with the stature of Indians of North and Central America. These data were arranged in two tables: (1) according to regions (and therefore somewhat by linguistic stocks), and (2) according to height classes (for example, those below 155 cm., those between 155–159.9 cm., 160–164.9 cm., etc.). Data for more than 100 tribes were supplied, along with a map showing the location and distribution of the statures of these Indians. Data dealing with cephalic indices of these tribes were similarly treated.

The purpose of the present article is to present, in a more or less similar form, the available data on stature for South American Indians. In preparing this paper more than 200 anthropological articles and books were reviewed. Of these, only a small proportion deal with the physical characteristics of the Indians. Hundreds of South American tribes are mentioned in the literature, but anthropometrical data for only eighty-two tribes were discovered. These data, as they relate to stature, have been assembled in this paper.[1]

No attempt is made to present a new classification of the existing tribal groups. Nothing new is said of the migratory movements of the people, nor of the language affinities. The

[1] In preparing this article the author is happy to acknowledge the assistance of Mrs. Hilda H. Wheeler and Miss Lena Ottolenghi. The maps were made by Miss Alice Hellmer, the staff artist.

data on stature and the related bibliography are merely assembled for convenient reference and to show the regional variations.

The writer is aware of the many variables which may render the tables of questionable value, and he should not be held responsible for the accuracy of the original data. He knows, for example, that many of the techniques of measuring represented in these figures may be inaccurate, and therefore may result in equally inaccurate means; that the means involved are often based on as few as four and five individuals, and consequently may be of very little value. The data in some cases may even be the result of a mere estimate on the part of an explorer or a roving anthropologist. In almost every study the authors fail to mention the nutritional and health status of the group concerned. In this regard the writer is aware that populations may change in physical characteristics over a period of a single generation, or even within as short a period as 10 years (cf. Steggerda, '42). In most cases the writer is positive that the anthropologists have not concerned themselves sufficiently with the genetic purity of the stock described. Nevertheless, he is convinced that in the mass these data come close to the true values and that they should be summarized.

To facilitate locating the eighty-two tribes for which stature has been determined, each has been given a number. The numbers with corresponding names are listed below the accompanying map (fig. 1) in serial order and also appear on the map in the places where the tribes live.

The student who is interested in identifying and locating the tribes of South American Indians may be puzzled by the various spellings of tribal names in the literature. He will notice that the names are spelled differently according to the language in which the author has written his report, thus, the name Chorote in Spanish becomes Tschorote in German. There are various ways of spelling Quechua; e.g., Quichua, Quichoua, Quitchoua, Kachua, and Quitschua. For Witoto we find such versions as Ouitoto, Huitoto, and Uiototo. Wapisiana

Fig. 1 Map of South America with numbers representing locations of tribes for which stature is supplied. The tribes represented by these numbers are as follows:

1. Alacaluf
2. Amahuaca
3. Angachua
4. Arara
5. Araucano
6. Aruaqui
7. Aturi
8. Aueto
9. Aymara
10. Bacairi
11. Bare
12. Bororo
13. Caingua
14. Cauixana
15. Cayapa
16. Chiriguano
17. Choco
18. Chorote
19. Conebo
20. Cuna
21. Guarani
22. Guayaki
23. Ipurina
24. Iamamadi
25. Karaja
26. Kamaiura
27. Kayapo
28. Mehinaku
29. Macushi
30. Mapidian
31. Machiganga
32. Macheyenga
33. Mataco
34. Maue
35. Miranha
36. Mundurucu
37. Mura
38. Nahucua
39. Nambicuara
40. Omagua
41. Ona
42. Otavalo
43. Paressi
44. Pariqui
45. Paumari
46. Piro
47. Puri
48. Quichua
49. Rama
50. San Blas
51. Sipibo
52. Setibo
53. Sumu
54. Takshik
55. Taruma
56. Tehuelche
57. Tembe
58. Tiatinagua
59. Ticuna
60. Toba
61. Trumai
62. Wapisiana
63. Umaua
64. Witoto
65. Yahgan
66. Yaruro
67. Botocudo
68. Cunco
69. Macu
70. Barama Carib
71. Goajiro
72. Chipaya
73. Chilote
74. Calchaqui
75. Chango
76. Mapuche
77. Pehuelche
78. Subandino
79. Uru
80. Waiwai
81. Kagaba
82. Dominica Carib

Note. Tribes represented by numbers 49 and 53 occur in Nicaragua and are not shown on the map.

is also spelled Uapisiana, Uapichiana, Wapichiana, and Wapischiana. Nambiquara in Spanish becomes Nambikuara in German. Some tribes, on the other hand, are known under several different names. Among them are the Caingang, also called Coroados, who have still other names according to the district which they inhabit; i.e., Bugres, Cames, Socre, and Xocren. In the spelling and naming of tribal groups used in this paper, we have attempted to follow the spelling of the country in which they are located.

At this point it might be of interest to record that some of the tribal names have a particular meaning. For example, Jivaro, according to Deniker, means "savage;" Coroado means "crowned;" and Orejones, a name given to Indians who pierce their ears, is derived from the Spanish word "oreja" meaning ear. Colorado Indians are called thus from the red color which they use on their faces. Barbudos is a Spanish name for "bearded men;" Yuracare means "white man" and is a Quechua word. Guayaki is composed of the common root "Guaya" and "Ki," the latter referring to the ferocity of the tribe. Botocudo is derived from the Spanish word "botoque," a wooden disk, and refers to the ornament these tribes wear in the lower lip.

ARRANGEMENT OF STATURES BY GEOGRAPHICAL REGIONS

The data on stature will be presented first of all by geographical regions (table 1). In arriving at the arbitrary limits of these regions the evidence of anthropometry, language, and physiography have all been taken into consideration. Thus the Indians who inhabit the headwaters of the Amazon are listed together, as are those of the highlands of Peru and the Chaco of Argentina and Bolivia. For each of these areas the average for each tribe is given, plus a weighted average for the entire group. The table shows that the shortest Indians are in northern and northwestern South America. Rather tall Indians live in southern Brazil and Bolivia, and the tallest groups are to be found in Argentina and Chile. The distributions of stature throughout the world have induced

TABLE 1

Average statures of South American Indians arranged in regional groups with a weighted average for each group.

TRIBE	NO. ON MAP	LINGUISTIC STOCK	MALES No. of individuals	MALES Average in cm.	FEMALES No. of individuals	FEMALES Average in cm.	SOURCE
Indians of the Panama region							
Sumu	53	Sumu-Mosquito	12	158.1	—	—	Schultz, '26
Rama	49	Tocantis	25	166.1	—	—	Schultz, '26
Choco	17		10	156.4	9	145.3	Hrdlička, '26
Cuna	20	Chibcha	27	154.9	20	143.2	Hrdlička, '26
Kagaba	81	Arawak	28	159.4	22	146.9	Mason, '40
San Blas	50		14	149.9	5	140.4	Harris, '26
		Weighted average		158.3		144.7	
Indians of north central area							
Goajiro	71	Arawak	24	150.9	11	143.8	Mason, '40
Yaruro	66	Independent					
(Mercedes)			8	160.2	7	148.4	Petrullo, '39
(Lagunote)			7	159.3	9	147.8	Petrullo, '39
(Burons)			4	160.6	5	148.9	Petrullo, '39
Barama River	70	Carib	104	156.82	99	145.75	Gillin, '36
Macushi	29	Carib	33	156.0	16	142.8	Farabee, '24
Macushi	29	Carib	3	158.6	6	147.9	Bastos de Avila, '37
Wapisiana	62	Arawak	4	162.6	6	151.4	Bastos de Avila, '37
Wapisiana	62	Arawak	9	157.3	—	—	Farabee, '18
Waiwai	80	Carib	36	158.9	10	146.7	Farabee, '24
Taruma	55	Arawak	9	159.6	5	146.1	Farabee, '18
Aturi	7	Arawak	4	159.2	4	142.5	Bastos de Avila, '37
Mapidian	30	Arawak	10	161.5	9	148.8	Farabee, '18
Dominica Caribs	82	Carib	27	161.8	12	148.6	Taylor
		Weighted average		157.6		146.2	
Indians of Ecuador							
Cayapa	15	Chibcha	19	155.1	21	146.4	Barrett, '25
Angachua	3	Quichua	25	158.3	—	—	Gillin, '41
Otavalo	42	Quichua	108	156.0	—	—	Gillin, '41
		Weighted average		156.3			
Indians of the headwaters of the Amazon							
Umaua	63	Carib	2	153.7	—	—	Bastos de Avila, '37
Bare	11	Arawak	1	154.5	—	—	Bastos de Avila, '37
Macu	69	Independent	—	161.0	—	—	Pericot, '36
Witoto	64	Independent	5	162.0	4	146.8	Farabee, '22
Witoto	64	Independent	—	—	—	139.5	Whiffen, '15
Cauixana	14		—	160.0	—	—	Roquette-Pinto, '38
Miranha	35	Tupi	—	160.0	—	—	Roquette-Pinto, '38
Ticuna	59	Arawak	—	149.0	—	—	Roquette-Pinto, '38
Omagua	40	Tupi	—	160.0	—	—	Roquette-Pinto, '38
Mura	37	Independent	—	154.0	—	—	Roquette-Pinto, '38
Paumari	45	Arawak	3	164.3	—	—	Lehmann-Nitsche, '08 b
Iamamadi	24	Arawak	4	159.8	—	—	Lehmann-Nitsche, '08 b
Ipurina	23	Arawak	8	158.7	—	—	Lehmann-Nitsche, '08 b
Arara	4	Carib	—	161.0	—	—	Roquette-Pinto, '38
		Weighted average		159.3		145.3	

TABLE 1 — (*Continued*)

TRIBE	NO. ON MAP	LINGUISTIC STOCK	MALES No. of individuals	MALES Average in cm.	FEMALES No. of individuals	FEMALES Average in cm.	SOURCE
			Indians of Central Brazil				
Aruaqui	6		—	145.0	—	—	Roquette-Pinto, '38
Maue	34	Tupi	—	158.0	—	—	Roquette-Pinto, '38
Pariqui	44		—	155.0	—	—	Roquette-Pinto, '38
Munduruсu	36	Tupi	—	160.0	—	—	Roquette-Pinto, '38
Puri	47		—	154.0	—	—	Roquette-Pinto, '38
Kayapo	27	Ges	5	167.6	2	154.5	Lehmann-Nitsche, '08 b
Tembe	57	Tupi	—	155.0	—	—	Roquette-Pinto, '38
		Weighted average		160.5			
			Indians of Southern Brazil and Bolivia				
Tiatinagua	58	Tupi	4	158.5	—	—	Farabee, '22
Paressi	43	Arawak	9	160.5	3	151.4	Lehmann-Nitsche, '08 b
Paressi	43	Arawak	—	155.0	—	—	Roquette-Pinto, '38
Nambikuara	39	Ges	18	162.0	7	147.0	Roquette-Pinto, '38
Machiganga	31		18	155.9	15	143.9	Ferris, '21
Trumai	61	Independent	8	159.1	—	—	Lehmann-Nitsche, '08 b
Trumai	61	Independent	14	159.5	14	148.8	Lehmann-Nitsche, '08 b
Nahucua	38	Carib	15	162.5	12	152.2	Bastos de Avila, '37
Nahucua	38	Carib	65	161.8	35	150.8	Lehmann-Nitsche, '08 b
Nahucua	38	Carib	15	168.7	12	148.0	Lehmann-Nitsche, '08 b
Bacairi	10	Carib	10	160.8	6	151.6	Ehrenreich, 1897
Bororo	12	Independent	20	173.7	6	160.6	Lehmann-Nitsche, '08 b
Aueto	8	Tupi	14	159.9	2	148.0	Ehrenreich, 1897
Aueto	8	Tupi	25	158.1	9	152.1	Lehmann-Nitsche, '08 b
Mehinacu	28	Arawak	6	164.0	6	151.2	Ehrenreich, 1897
Mehinacu	28	Arawak	6	162.9	6	151.0	Lehmann-Nitsche, '08 b
Kamaiura	26	Tupi	14	164.1	4	153.7	Lehmann-Nitsche, '08 b
Karaja	25	Independent	12	168.9	9	152.8	Lehmann-Nitsche, '08 b
		Weighted average		162.4		150.4	
			Indians of the highlands of Peru and Northern Bolivia				
Conebo	19	Pano	—	147.0	—	—	Roquette-Pinto, '38
Conebo	19	Pano	3	161.0	—	—	Farabee, '22
Macheyenga	32	Arawak	19	161.0	—	—	Farabee, '22
Amahuaca	2	Pano	2	160.0	—	—	Farabee, '22
Sipibo	51	Pano	14	156.8	—	—	Farabee, '22
Piro	46	Arawak	23	161.3	8	151.0	Farabee, '22
Setibo	52	Pano	3	158.0	—	—	Farabee, '22
Quichua	48	Quichua	123	158.3	1	142.6	Ferris, '21 [1]
Quichua	48	Quichua	85	158.4	68	145.4	Ferris, '21
Quichua	48	Quichua	67	160.5	8	154.0	Chervin, '07
Quichua	48	Quichua	25	157.2	—	—	Rouma, '13 [2]
Quichua	48	Quichua	25	159.2	—	—	Rouma, '13 [3]
Aymara	9	Quichua	104	159.2	7	147.8	Chervin, '07
Aymara	9	Quichua	25	160.8	—	—	Rouma, '13 [4]
Aymara	9	Quichua	25	155.0	—	—	Rouma, '13 [5]
Chipaya	72	Tupi	1	145.5	—	—	Posnansky, '18
		Weighted average		158.9		146.8	

[1] 1912 expedition. [2] Finca de Potola. [3] Finca de Anfaya. [4] Finca de Pillapi. [5] Finca de St. Rosa.

TABLE 1 — (*Continued*)

TRIBE	NO. ON MAP	LINGUISTIC STOCK	MALES		FEMALES		SOURCE
			No. of individuals	Average in cm.	No. of individuals	Average in cm.	
		Indians of Southern Bolivia and Northern Argentina					
hango	75	Araucano	—	160.0	—	145.0	Latcham, '09
horote	18	Mataco	20	161.6	10	155.3	Lehmann-Nitsche, '08 b
Iataco	33	Mataco	30	163.8	20	152.9	Lehmann-Nitsche, '08 b
alchaqui	74	Quichua	6	168.5	—	—	Ten Kate, 1896
oba	60	Guaycuru	20	169.8	10	155.5	Lehmann-Nitsche, '08 b
hiriguano	16	Tupi	40	163.4	10	151.7	Lehmann-Nitsche, '08 b
hiriguano	16	Tupi	4	160.1	—	—	Lehmann-Nitsche, '08 b
akshik	54	Guaycuru	2	163.3	7	160.7	Lehmann-Nitsche, '04
uarani	21	Tupi	6	153.0	3	142.7	Lehmann-Nitsche, '08 b
uayaki	22	Tupi	—	151.0	—	—	Vellard, '34
uayaki	22	Tupi	—	—	1	144.5	Lehmann-Nitsche, '08 a
aingua	13	Tupi	2	154.5	2	147.0	Lehmann-Nitsche, '08 b
otocudo	67	Ges	10	158.6	—	—	Eickstedt, '34
		Weighted average		163.2		152.5	
		Indians of Southern Argentina and Chile					
raucano	5	Araucano	—	163.3	—	143.0	Latcham, '04
raucano	5	Araucano	2	162.0	1	157.7	Lehmann-Nitsche, '08 b
raucano	5	Araucano	4	162.0	1	147.8	Lehmann-Nitsche, '08b
Iapuche	76	Araucano	31	161.0	19	143.2	Latcham, '09
ubandino	78	Araucano	11	164.3	6	147.5	Latcham, '09
unco	68	Araucano	—	155.0	—	—	Pericot, '36
ehuelche	77	Araucano	—	169.0	—	—	Latcham, '09
hilote	73	Araucano	—	146.0	—	138.0	Latcham, '09
hilote	73	Araucano	—	146.0	—	138.0	Pericot, '36
hilote	73	Araucano	50	160.3	—	—	Outes, '09
ehuelche	56	Tehuelche	3	168.9	—	—	Lehmann-Nitsche, '08 b
ehuelche	56	Tehuelche	3	179.3	—	—	Lehmann-Nitsche, '08 b
ehuelche	56	Tehuelche	3	176.5	—	—	Lehmann-Nitsche, '16 b
ehuelche	56	Tehuelche	—	180.0	—	168.0	Latcham, '09
na	41	Independent	24	172.9	22	160.3	Lehmann-Nitsche, '08 b
na	41	Independent	25	175.4	34	159.2	Lothrop, '28
na	41	Independent	1	182.0	—	—	Lehmann-Nitsche, '27
na	41	Independent	8	170.8	7	156.1	Lehmann-Nitsche, '27
na	41	Independent	20	174.1	30	159.6	Lehmann-Nitsche, '08 b
na	41	Independent	3	178.1	11	157.7	Outes, '09
na	41	Independent	2	183.5	2	168.0	Lehmann-Nitsche, '27
na	41	Independent	2	176.0	2	159.2	Lehmann-Nitsche, '08 b
ahgan	65	Independent	269	158.5	160	149.0	Latcham, '09
ahgan	65	Independent	26	157.1	23	147.4	Hyades & Deniker, 1883
ahgan	65	Independent	67	157.7	55	147.3	Lehmann-Nitsche, '08 b
ahgan	65	Independent	67	158.1	56	147.5	Lothrop, '28
ahgan	65	Independent	—	—	1	154.7	Lehmann-Nitsche, '16 c
ahgan	65	Independent	6	161.4	—	—	Virchow, 1881
ahgan	65	Independent	14	160.0	19	147.8	Gusinde, '31–'37
ahgan	65	Independent	—	161.2	—	155.0	Garson, 1885
lacaluf	1	Independent	—	—	2	146.4	Lehmann-Nitsche, '16 a
lacaluf	1	Independent	2	159.7	7	151.1	Outes, '09
lacaluf	1	Independent	—	161.2	—	151.6	Garson, 1885
lacaluf	1	Independent	15	154.7	16	143.2	Eickstedt, '34
lacaluf	1	Independent	—	162.0	—	148.7	Latcham, '09
		Weighted average		160.9		150.4	

anthropologists to advance the theory that nutrition may have something to do with differential height and body build among the various Indian tribes. It might be worth mentioning briefly that the Indians of the southernmost part of Argentina and of Chile live largely on meat and fish, while the short tribes of the north subsist mostly on fruits and certain roots. This, however, is outside the scope of the present title.

ARRANGEMENT OF STATURES ACCORDING TO HEIGHT CLASSES

In table 2 the statures of the males are arranged from the shortest to the tallest. The range in stature is even greater than that found for North American Indians (Steggerda, '32), since North and Central American Indians ranged from the short "San Blas" Indians (Tules) of Harris ('26), who recorded them as 149.9 cm., to the Dakota Indians of 175.7 cm., as recorded by Wissler ('11). Bean ('31) in citing average statures of European Whites says, "The extremes are one group of 'indigent French' with a stature of 156.0 cm., and a group of Scotch farmers with a stature of 181.2 cm." The South American Indians have an even greater range. The Aruaqui males, as recorded by Roquette-Pinto ('38), average 145 cm., and the Onas, recorded by Lehmann Nitsche ('27), average 183.5 cm.

Anyone familiar with average figures of populations will immediately criticise this range in stature, since the number of individuals for the low figure of 145 cm. is not given, and the high figure of 183.5 cm. is based on only two cases. If one begins, however, with the very adequate number of cases (108) as supplied by Gillin ('41) for the Otavalo Indians and ends with the Onas of Lehmann Nitsche's study of 1908, in which he describes twenty individuals, one obtains a range of 156 cm. to 174 cm., which is very similar to that arrived at for the North American Indian groups.

In figure 2 these statures of South American Indian males are plotted according to size. The small statures below 160 cm. are found in the northwest and they continue southeastward to more or less the center of the continent, with a few

TABLE 2

Average statures of South American male Indians arranged from the shortest to the tallest.

TRIBE	NUMBER ON MAP	NUMBER OF INDIVIDUALS	AVERAGE IN CM.	SOURCE
		Below 155 cm.		
Aruaqui	6	—	145.0	Roquette-Pinto, '38
Chipaya	72	1	145.5	Posnansky, '18
Chilote	73	—	146.0	Latcham, '19
Conebo	19	—	147.0	Roquette-Pinto, '38
Ticuna	59	—	149.0	Roquette-Pinto, '38
San Blas	50	14	149.9	Harris, '26
Goajiro	71	24	150.9	Mason, '40
Tembe	57	7	150.9	Lopes, '32
Guayaki	22	—	151.0	Vellard, '34
Guarani	21	6	153.0	Krone, '06
Umaua	63	2	153.7	Bastos de Avila, '37
Mura	37	—	154.0	Roquette-Pinto, '38
Puri	47	—	154.0	Roquette-Pinto, '38
Bare	11	1	154.5	Bastos de Avila, '37
Caingua	13	2	154.5	Lehmann-Nitsche, '08 b
Cuna	20	27	154.9	Hrdlička, '26
		155 cm. to 159.9 cm.		
Cunco	68	—	155.0	Pericot, '36
Tembe	57	—	155.0	Roquette-Pinto, '38
Aymara	9	25	155.0	Rouma, '13
Pariqui	44	—	155.0	Rouquette-Pinto, '38
Paressi	43	—	155.0	Rouquette-Pinto, '38
Cayapa	15	19	155.1	Barrett, '25
Machiganga	31	18	155.9	Ferris, '21
Otavalo	42	108	156.0	Gillin, '41
Macushi	29	33	156.0	Farabee, '24
Choco	17	10	156.4	Hrdlička, '26
Sipibo	51	14	156.8	Farabee, '22
Barama Carib	70	104	156.8	Gillin, '36
Aymara	9	111	157.0	Eickstedt, '34
Yahgan	65	26	157.1	Hyades & Deniker, 1883
Urubu	57	4	157.1	Lopes, '32
Quichua	48	25	157.2	Rouma, '13 [1]
Wapisiana	62	9	157.3	Farabee, '18
Alacaluf	1	8	157.4	Lehmann-Nitsche, '08 b
Yahgan	65	67	157.7	Lehmann-Nitsche, '08 b
Maue	34	—	158.0	Roquette-Pinto, '38
Alacaluf	1	—	158.0	Pericot, '36
Setibo	52	3	158.0	Farabee, '22
Aueto	8	25	158.1	Lehmann-Nitsche, '08 b
Sumu	53	12	158.1	Schultz, '26
Yahgan	65	67	158.1	Lothrop, '28
Angachua	3	25	158.3	Gillin, '41
Quichua	48	123	158.3	Ferris, '21
Quichua	48	121	158.4	Ferris, '16

[1] From Finca de Potola.

TABLE 2 — (*Continued*)

TRIBE	NUMBER ON MAP	NUMBER OF INDIVIDUALS	AVERAGE IN CM.	SOURCE
		155 cm. to 159.9 cm. — (*Continued*)		
Quichua	48	85	158.4	Ferris, '21
Tiatinagua	58	4	158.5	Farabee, '22
Yahgan	65	269	158.5	Latcham, '19
Botocudo	67	10	158.6	Eickstedt, '34
Macushi	29	3	158.6	Bastos de Avila, '37
Ipurina	23	8	158.7	Lehmann-Nitsche, '08 b
Waiwai	80	36	158.9	Farabee, '24
Yahgan	65	—	159.0	Serrano, '30
Trumai	61	8	159.1	Lehmann-Nitsche, '08 b
Quichua	48	25	159.2	Rouma, '13 [2]
Aturi	7	4	159.2	Bastos de Avila, '37
Aymara	9	104	159.2	Chervin, '07
Yaruro (Lagunote)	66	7	159.3	Petrullo, '39
Kagaba	81	28	159.4	Mason, '40
Trumai	61	14	159.5	Lehmann-Nitsche, '08 b
Taruma	55	9	159.6	Farabee, '18
Alacaluf	1	2	159.7	Outes, '09
Iamamadi	24	4	159.8	Lehmann-Nitsche, '08 b
Aueto	8	14	159.9	Ehrenreich, 1897
		160 to 164.9 cm.		
Amahuaca	2	2	160.0	Farabee, '22
Cauixana	14	—	160.0	Roquette-Pinto, '38
Chango	75	—	160.0	Latcham, '19
Miranha	35	—	160.0	Roquette-Pinto, '38
Mundurucu	36	—	160.0	Roquette-Pinto, '38
Omagua	40	—	160.0	Roquette-Pinto, '38
Quichua	48	—	160.0	Ferris, '21
Yahgan	65	14	160.0	Gusinde, '30
Chiriguano	16	4	160.1	Lehmann-Nitsche, '08 b
Yaruro	66	8	160.2	Petrullo, '39
Chilote	73	50	160.3	Outes, '09
Paressi	43	9	160.5	Lehmann-Nitsche, '08 b
Quichua	48	67	160.5	Chervin, '07
Yaruro	66	4	160.6	Petrullo, '39
Aymara	9	25	160.8	Rouma, '13
Bacairi	10	10	160.8	Ehrenreich, 1897
Arara	4	—	161.0	Roquette-Pinto, '38
Conebo	19	3	161.0	Farabee, '22
Macu	69	—	161.0	Pericot, '36
Macheyenga	32	19	161.0	Farabee, '22
Mapuche	76	31	161.0	Latcham, '19
Alacaluf	1	—	161.2	Garson, 1885
Yahgan	65	—	161.2	Garson, 1885
Piro	46	23	161.3	Farabee, '22
Yahgan	65	6	161.4	Virchow, 1881
Mapidian	30	10	161.5	Farabee, '18
Chorote	18	20	161.6	Lehmann-Nitsche, '08 b
Dominica Carib	82	27	161.8	Taylor

[2] From Finca de Anfaya.

TABLE 2 — (*Continued*)

TRIBE	NUMBER ON MAP	NUMBER OF INDIVIDUALS	AVERAGE IN CM.	SOURCE
		160 to 164.9 cm. — (*Continued*)		
Nahucua	38	65	161.8	Lehmann-Nitsche, '08 b
Araucano	5	4	162.0	Lehmann-Nitsche, '08 b
Araucano	5	2	162.0	Lehmann-Nitsche, '08 b
Alacaluf	1	18	162.0	Roquette-Pinto, '38
San Blas	50	1	162.0	Feeney, '41
Witoto	64	5	162.0	Farabee, '22
Nahucua	38	15	162.5	Bastos de Avila, '37
Wapisiana	62	4	162.6	Bastos de Avila, '37
Araucano	5	—	163.0–163.5	Latcham, '04
Takshik	54	2	163.3	Lehmann-Nitsche, '04
Chiriguano	16	40	163.4	Lehmann-Nitsche, '08 b
Chorote	18	—	163.5	Pericot, '36
Mataco	33	30	163.8	Lehmann-Nitsche, '08 b
Mehinacu	28	6	164.0	Ehrenreich, 1897
Kamaiura	26	14	164.1	Lehmann-Nitsche, '08 b
Paumari	45	3	164.3	Lehmann-Nitsche, '08 b
Subandino	78	11	164.3	Latcham, '09
		165 to 169.9 cm.		
Rama	49	25	166.1	Schultz, 26
Kayapo	27	5	167.6	Lehmann-Nitsche, '08 b
Calchaqui	74	6	168.5	Ten Kate, 1896
Nahucua	38	15	168.7	Lehmann-Nitsche, '08 b
Tehuelche	56	3	168.9	Lehmann-Nitsche, '08 b
Karaya	25	12	168.9	Lehmann-Nitsche, '08 b
Pehuelche	77	—	169.0	Latcham, '19
Toba	60	20	169.8	Lehmann-Nitsche, '08 b
		170 to 174.9 cm.		
Ona	41	—	170.0	Serrano, '30
Ona	41	8	170.8	Lehmann-Nitsche, '27
Ona	41	24	172.9	Lehmann-Nitsche, '08 b
Bororo	12	20	173.7	Lehmann-Nitsche, '08 b
Ona	41	20	174.1	Lehmann-Nitsche, '08 b
		175 to 179.9 cm.		
Ona	41	25	175.4	Lothrop, '28
Bororo	12	—	176.0	Pericot, '36
Ona	41	2	176.0	Lehmann-Nitsche, '08 b
Tehuelche	56	—	176.5	Lehmann-Nitsche, '16 b
Ona	41	3	178.1	Lehmann-Nitsche, '08 b
Tehuelche	56	3	179.3	Lehmann-Nitsche, '08 b
		180 to 184.9 cm.		
Tehuelche	56	—	180.0	Latcham, '09
Ona	41	1	182.0	Lehmann-Nitsche, '27
Ona	41	2	183.5	Lehmann-Nitsche, '27

scattered groups in southern Paraguay and Brazil. Those between 160 and 165 cm. occupy nearly the same area, but continue farther south along the western part of the continent, far into the present country of Chile. The next taller group of 165 to 170 cm. occupies a long, narrow strip from northern Brazil to southern Argentina. Still taller Indians, those above 170 cm., are found in the southern part of South America, and at its southernmost tip. A small group of very tall Indians, the Bororos, occupies a small region in central Brazil, as indicated on the map. It will be noticed that the

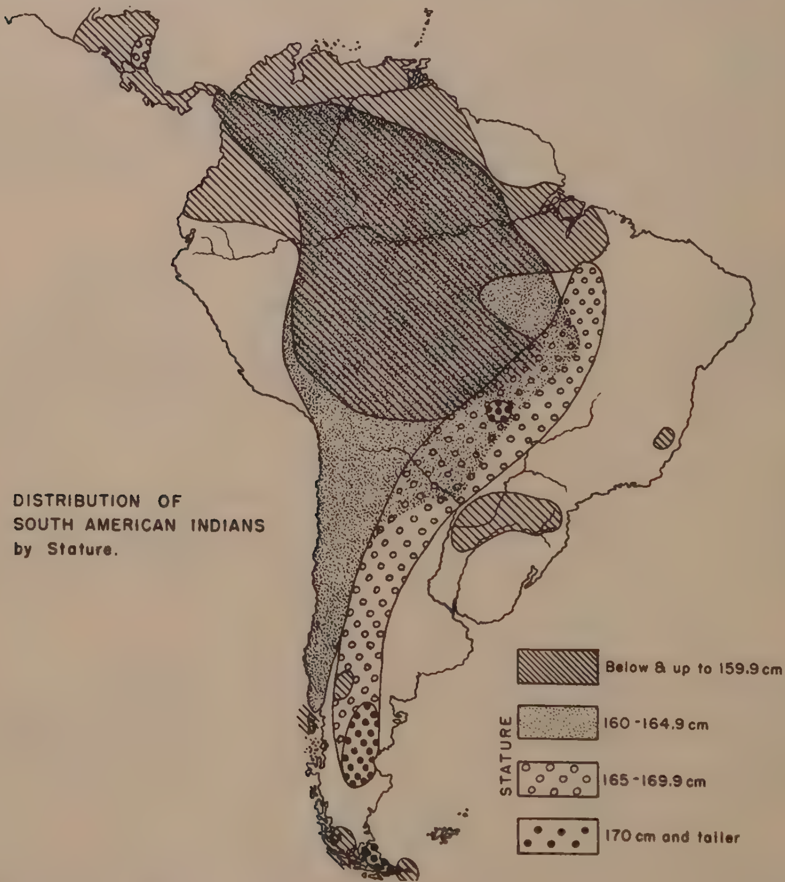

Fig. 2 Map showing distribution of male Indian statures in South America.

littoral regions of Brazil, Uruguay and Argentina, as well as Peru, are lacking in anthropometric data. Some studies in general anthropology have been made on Indians in these areas, but for them anthropometry is lacking.

COMMENT

This study, while it does not claim to have exhausted the sources, probably includes the majority of the available data on Indian stature. From this point of view it emphasizes the fact that very few groups have been adequately studied. If this is true for stature, which is the most commonly taken measurement and the least subject to error, it is even more true of other characters. Every effort should be made to obtain these anthropometric data on groups still remaining in a relatively pure state while there is yet time.

The method employed in this study admittedly is crude in the sense that it includes figures on inadequate samples. In some instances a series may have been incorporated in a larger one, which is also given. Obviously, it would be desirable to assemble all the individual measurements on a tribe until an adequate sample was available for statistical analysis. This has been done, for example, for the Ona and Yahgan by Hooton (see Lothrop, '28). Because many of the linguistic stocks are widely dispersed, such studies offer encouraging possibilities.

SUMMARY

The material presented in this paper concerns the names, locations, and stature of eighty-two South American Indian tribes. The data are presented in tables, according to regional areas, and also by height classes. It can be stated that the smallest Indians (below 160 cm.) are located in the northwest and toward the central portion of South America. The next group (160 to 165 cm.) live practically in the same area, but continue farther south along the western territory of the continent, which is now Chile. The third group (165 to 170 cm.) is found along a narrow strip from northern Brazil and

continues to the south as far as southern Argentina. The fourth and last group, i.ę., the tallest (above 170 cm.), is located in the southernmost part of Argentina and the Archipelago. The only tribe of this tall group found in central Brazil is the Bororos, an isolated group of Indians.

LITERATURE CITED

BARRETT, S. A. 1925 The Cayapa Indians of Eduador. Indian Notes and Mon., Mus. Am. Indian, Heye Found., N. Y., Misc. Ser., vol. 40, pts. 1 and 2.

BEAN, R. B. 1931 Stature of old Virginians. Am. J. Phys. Anthrop., vol. 15, pp. 355–419.

CHERVIN, ARTHUR 1907 Anthropologie Bolivienne. Tome 2, Anthropometrie, Paris.

BASTOS DE AVILA 1937 Contribuçao ao estudo antropofísico do Indio Brasileiro. Bol. Mus. Nac. Rio de Janeiro, vol. 13, nos. 3 and 4.

EHRENREICH, PAUL M. A. 1897 Anthropologische Studien über die Urbewohner Brasiliens. Braunschweig, 165 pp.

EICKSTEDT, EGON FREIHERR VON 1934 Rassenkunde und Rassengeschichte der Menschheit. Stuttgart, 936 pp. (see: The races of the southern continent, pp. 720–760).

FARABEE, W. C. 1918 The Arawaks of northern Brazil and southern British Guiana. Am. J. Phys. Anthrop., vol. 1, pp. 427–442.

———— 1922 Indian tribes of eastern Peru. Papers Peabody Mus. Archeol. and Ethnol., Harvard Univ., vol. 10, p. 195.

———— 1924 The central Caribs. Anthrop. Publ. Univ. Penn. Mus., vol. 10.

FEENEY, B. C. 1941 Arch isolationists. The San Blas Indians. Nat. Geogr. Mag., vol. 79, pp. 193–220.

FERRIS, H. B. 1921 Anthropological studies on the Quichua and Machiganga Indians. Trans. Conn. Acad. Arts and Sci., vol. 25, pp. 3–92.

GARSON, J. G. 1885 On the inhabitants of Tierra del Fuego. J. Anthrop. Inst. Gr. Brit. and Ire., vol. 15, pp. 141–160.

GILLIN, JOHN 1936 The Barama River Caribs of British Guiana. Papers Peabody Mus. Archeol. and Ethnol., Harvard Univ., vol. 14, no. 2, 274 pp.

———— 1941 The Quichua-speaking Indians of the Province of Imbabura (Ecuador) and their anthropometric relations with the living populations of the Andean area. Bull. Bur. Am. Ethnol., no. 128, art. 16, pp. 167–228.

GUSINDE, MARTIN 1931–1937 Die Feuerland Indianer. I. Die Selk'nam (1154 pp.); II. Die Yamana (1482 pp.). Wien-Mödling.

HARRIS, R. G. 1926 The San Blas Indians. Am. J. Phys. Anthrop., vol. 9, pp. 17–65.

HRDLIČKA, ALEŠ 1926 The Indians of Panama. Their physical relation to the Maya. Am. J. Phys. Anthrop., vol. 9, pp. 1–15.

HYADES, PAUL D. J., AND J. DENIKER 1882–1883 Mission scientifique du Cap Horn. Anthropologie, ethnographie (Tierra del Fuego). Tome 7.

KRONE, R. 1906 Die Guarany Indianer am Itariri, Sao Paulo in Brasilien. Mitt. anthrop. Gesell. Wien, vol. 36, pp. 130–146.

LATCHAM, R. E. 1904 Notes on the physical characteristics of the Araucanos. J. Anthrop. Inst. Gr. Brit. and Ire., vol. 34, pp. 170–180.

——— 1909 Antropología Chilena. Rev. Mus. La Plata, vol. 16, pp. 241–319.

LEHMANN-NITSCHE, R. 1904 Etudes anthropologiques sur les Indiens Takshik du Gran Chaco argentin. La Plata.

——— 1908 a Relevamiento antropológico de una india Guayaquí. Rev. Mus. La Plata, tomo 15 (Seg. ser. tomo 2), pp. 91–101.

——— 1908 b Estudios antropológicos sobre los Chiriguanos, Chorotes, Matacos y Tobas (Chaco Occidental). An. Mus. La Plata, seg. ser. tomo 1, 149 pp.

——— 1916 a Relevamiento antropológico de dos indias Alacaluf. Rev. Mus. La Plata, tomo 23 (Seg. ser. tomo 10, pt. 2), pp. 188–191.

——— 1916 b Relevamiento antropológico de tres indios Tehuelche. Rev. Mus. La Plata, tomo 23 (Seg. ser. tomo 10), pp. 192–195.

——— 1916 c Relevamiento antropológico de una india Yagan. Rev. Mus. La Plata, tomo 23 (Seg. ser. tomo 10), pp. 185–187.

——— 1927 Estudios antropológicos sobre los Onas (Tierra del Fuego). An. Mus. La Plata, seg. ser. tomo 2, 99 pp.

LOPES, R. 1932 Os Tupis do Gurupy. Actas y trabajos del XXV. Congreso Internacional de Americanistas, tomo 1, pp. 139–171. (See p. 141, "Os caracteres fisicos.")

LOTHROP, S. K. 1928 The Indians of Tierra del Fuego. Contr. Mus. Am. Indian, Heye Found. N. Y., 244 pp. (See p. 41 for article by Hooton.)

MASON, GREGORY 1940 South of yesterday. New York.

OUTES, FÉLIX 1909 Comunicación preliminar sobre los resultados antropológicos de mi primer viaje a Chile. Univ. Nac. La Platas, pp. 216–221.

PERICOT Y GARCÍA, L. 1936 La America indígena., vol. 1, pp. 593–727, Barcelona.

PETRULLO, VINCENZO 1939 The Yaruros of the Capanapero River of Venezuela. Bull. Bur. Am. Ethnol., no. 123, pp. 161–291.

POSNANSKY, ARTHUR 1918 Los Chipayas de Carangas. La Paz.

——— 1937 Antropología y sociología de las razas interandinas y de las regiones adyacentes. La Paz, 150 pp.

ROQUETTE-PINTO, E. 1938 Rondonia. Brasiliana. Biblioteca Pedagógica Brasileira, vol. 39, 399 pp.

ROUMA, GEORGES 1913 Les Indiens Quichouas et Aymaras des hauts plateaux de la Bolivie. Bruxelles.

SERRANO, ANTONIO 1930 Los primitivos habitantes del territorio Argentino. Arqueología y etnología argentinas. Buenos Aires, 183 pp.

SCHULTZ, A. H. 1926 Anthropological studies on the Nicaraguan Indians. Am. J. Phys. Anthrop., vol. 9, pp. 65–80.

STEGGERDA, M. 1932 Anthropometry of adult Maya Indians. A study of their physical and physiological characteristics. Publ. Carnegie Inst. Washington, no. 434, 113 pp.

——— 1942 Annual Report, Yearbook. Carnegie Institution of Washington, pp. 211–216.

TAYLOR, DOUGLAS The Caribs of Dominica. Unpublished manuscript.

Ten Kate, Herman F. C. 1896 Anthropologie des anciens habitants de la région Calchaquie (République Argentine). An. Mus. La Plata, vol. 1, pp. 1–62.

Vellard, J. 1934 Les Indiens Guayakí. J. Soc. Am. Paris, vol. 26, pp. 223–292.

Virchow, R. 1881 Die Feuerländer. Verhandl. Berl. Gesell. Anthrop., Ethnogr. u. Urgesch., pp. 375–394.

Whiffen, Th. 1915 The North-West Amazons. Duffield and Co., New York.

Wissler, C. 1911 Measurements of Dakota Indian children. An. N. Y. Acad. Sci., vol. 20, no. 7, pt. 2, pp. 355–364.

A METRIC STUDY OF UNDEFORMED INDIAN CRANIA FROM PERU

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Despite the large bulk of the literature on Peruvian craniology (see Dorsey, 1898, Hrdlička, '11), few attempts have been made toward a synthesis of the racial history of that country. And even these few attempts[1] have been rather disappointing, since poor archaeological documentation of specimens, cranial deformation, and lack of strict comparability in measuring techniques have tended to obscure the results. I became aware of the limitations of the published data upon Peruvian crania while preparing the section on the aboriginal skeletal material for the forthcoming "Handbook of South American Indians" of the Bureau of American Ethnology. In view of this situation and the fact that I have access to some new material, it seemed worthwhile to analyze such available craniometric data for which adequate archaeological documentation and metric techniques are afforded. Since the "Handbook" article is to be very condensed, it is desirable in my opinion to publish this analysis separately and in full.

MATERIAL

The analysis deals with five cranial series from Peru which have not, for the most part, heretofore been compared and, with the exception of that from the Chicama Valley, are most

[1] The most rceent synthesis is that of Hoyos Sainz ('23, '24) of which I have seen only the first part. Not having seen the whole of this work, I am not in a position to comment upon it. Hrdlička ('14) has reported upon his field impressions of crania that he saw along the coast and in one area in the sierra. This is valuable in view of Doctor Hrdlička's wide experience in the American Indian field.

certainly Late period in date. These are the only series known to me that even partially satisfy the requirements listed above.[2] The five series are as follows:

1. Chancay.[3] Eighty-two male and thirty-one female crania from the central coast valleys of Chancay and Chillón (Newman, '43). The Chancay crania (forty-one males, thirty-one females) were collected by the writer from the surface at Lauri and Cerro de la Trinidad, which seem to be exclusively Late Chancay (Late period I) sites. The forty-one Chillón male crania are from the surface of the Marquez site, which has yielded only the type of ceramics termed "Sub-Chancay" by Kroeber ('26, p. 335). Dr. J. C. Tello collected these crania and kindly made them available to the writer. In the pooled Chancay male series only apparently undeformed crania were used in seriations involving measurements and indices influenced by cranial deformation. In the much more meager female series slightly deformed crania are included (see p. 25).

2. Miscellaneous Chicama. Sixty-five male and fifty-eight female crania from the northern coastal valleys of Chicama and Moche (Stewart, '43). Of this series fifty of each sex are from the collections of the U. S. National Museum and were obtained from the surface of some thirty sites in the Chicama Valley by Hrdlička in 1910 and 1913. This collection probably spans the Early (Mochica), Middle, and Late periods, but may appertain largely to the last-mentioned. The rest are from the Larco collection at Chiclín in Peru, and are associated with the Mochica culture. This Miscellaneous Chicama series has been selected for apparent freedom from cranial deformation.

3. San Damian. Sixty-seven male and sixty-one female crania from near the modern sierra town of San Damian in the Department of Huarochirí some 70 km. directly east of

[2] Doctor Newman had completed this paper and departed for military service when the paper by Quevedo ('42), which is reviewed in this issue, appeared. —Editor.

[3] These names will be used throughout in referring to the series.

Lima. This series was collected by Hrdlička and Tello in 1913, and has been measured by the writer at the U. S. National Museum for the present study. Doctor Tello states that these crania are late in time, by which I assume he means the Late period. All the San Damian collection, excepting one skull,[4] is undeformed.

4. *Paucarcancha.* One hundred and seventeen male and seventy-four female crania from a number of caves or rock shelters mostly along the Urubamba drainage (MacCurdy, '23). The writer performed the seriations, excluding deformed crania when indicated. These caves and the number of osteological specimens from each are listed by MacCurdy as follows:

Paucarcancha	192	Sillque	4
Patallacta (Qquente)	92	Huispang	1
Torontoy	30	Huarocondo (not in Urubamba drainage)	1
Huata	17		
Yanamanchi	4		

Although most of the caves are adjacent to demonstrably Inca ruins, it is not certain that the skeletons were placed there in Inca times. Since only a few plain sherds were found in the caves, a definite assignment of the occupation to the Late period is precluded. Thus the Paucarcancha series was probably Late, but may conceivably have been earlier than the Inca spread into that area.

5. *Machu Picchu.* Thirty-eight female crania from a large number of caves or rock shelters surrounding the citadel of Machu Picchu at the junction of the Urubamba and Apurimac Rivers (Eaton, '16). The writer seriated the metric data, eliminating the crania assessed by Eaton as deformed. According to Means ('31, p. 534), Machu Picchu itself "certainly does not antedate the Inca Pachacutec [c. 1400–1448 A.D.]." The pottery from some of the caves (see Eaton, '16, plates 5–14) appears to be classic Inca. Thus it seems quite evident

[4] This skull showed circular deformation. Upon being informed of this Doctor Hrdlička stated that the skull probably had been accidentally and incorrectly included in the San Damian collection.

that the Machu Picchu crania are Late period in date, and most probably appertain to phase II of that period.

CRANIAL DEFORMATION

It is not the purpose of this study to discuss the mechanical and distributional aspects of deformation. Imbelloni ('33) has, in a very general way, plotted the primary types of deformation over the Americas. He has also discussed the aboriginal methods of achieving these various types. Stewart ('43) and Newman ('43) have reported upon the chronological aspects of deformation along the Peruvian coast.

Here, in so far as possible, I have endeavored to deal with completely undeformed crania. Thus Stewart's Miscellaneous Chicama series was selected to exclude deformation. The San Damian collection is completely undeformed, so no selection was required. For the Paucarcancha series deformed crania were eliminated from the seriations of measurements and indices influenced by deformation. The same was done for the Machu Picchu series, but the writer felt less assured than with the Paucarcancha crania that Eaton had detected cases of slight deformation.[5]

In handling the Chancay series I at first lumped the slightly deformed crania with the undeformed, in an effort to achieve a close approximation to the undeformed means and still have a fairly sizable series. Later I questioned this procedure and seriated those measurements and indices affected by deformation for the undeformed crania alone. The differences in the pooled Chancay males between these first and second seriations are given in table 1.

As can be seen, the differences are quite considerable, and do not justify the use of even slightly deformed crania in such seriations. There remains a possibility that these dif-

[5] In three of nine Machu Picchu crania examined by the writer, he disagreed with Eaton's assessment of deformation. Eaton claimed these three to be undeformed, but my designations are as follows: 3195 — questionable frontal flattening; 3197 — questionable occipital flattening; 3198 — questionable circular deformation. Thus Eaton apparently did not recognize very light deformation as such.

ferences are not wholly due to deformation, but also to some physical distinctness between the slightly deformed and undeformed crania. It seems quite safe, however, to attribute most of the above differences to deformation.

Of the measurements and indices given in table 1, only the undeformed Chancay males are used in this report. The Late Chancay female series unfortunately is too small to be treated in the same way; in this case the slightly deformed and undeformed crania are seriated together. For this reason these

TABLE 1

Metrical effect of elimination of slightly deformed crania: Chancay males.

MEASUREMENT (MM.) OR INDEX	UNDEFORMED AND SLIGHTLY DEFORMED	UNDEFORMED ALONE	DIFFERENCE
Glabello-occipital length	(58) 172.19	(26) 174.04	+ 2.15
Maximum breadth	(58) 141.50	(26) 139.85	— 1.65
Basion-bregma height	(58) 132.22	(26) 132.58	+ .36
Basion-nasion length	(82)* 99.02	(25) 99.76	+ .74
Basion-prosthion length	(70)* 97.80	(22) 98.64	+ .84
Total facial breadth	(80)*137.42	(27) 135.56	— 1.86
Length-breadth index	(58) 82.12	(25) 80.32	— 1.80
Length-height index	(58) 76.98	(26) 76.19	— .79
Breadth-height index	(58) 93.49	(25) 95.16	+ 2.67
Mean height index	(57) 84.44	(25) 84.35	— .09
Upper facial index	(64)* 52.05	(23) 52.48	+ .43

* Includes all crania, regardless of deformation.

means must be considered only close approximations to what might be expected in a wholly undeformed series. Thus in those particular cases where the Chancay females show significant differences with other series, whereas the males do not, the female differences have been discounted as due to the slight deformation.

It is probably impossible to determine whether those skulls selected for apparent lack of deformation were totally uninfluenced by it. Lacking any flattened planes and/or asymmetry, the observer is forced to assess a skull as undeformed, whereas it may have been slightly influenced by some sort of external pressure in infancy. This reservation must be kept in mind in the ensuing analysis.

MEASURING TECHNIQUES

The writer ('43) has given a full account of his measuring techniques used on the Chancay series. The San Damian material was treated in the same way. Stewart and MacCurdy follow Hrdlička ('20, '39), and Eaton states that he used those techniques recommended by Hrdlička at an earlier time. Because my techniques differ in some respects from those of Hrdlička, it seemed advisable for me to remeasure samples of Stewart's and Eaton's series to determine the extent of the differences. MacCurdy's Paucarcancha series was sent back to Peru, so it was impossible to check his techniques.

Table 2 shows the mean differences between my measurements and indices and those of Stewart and Eaton. The bases for this comparison are thirty male and thirty female random crania from the Miscellaneous Chicama series in the U. S. National Museum, and nine female crania from Machu Picchu kindly loaned to me by the Peabody Museum, Yale University. The latter is really too small a lot for adequate comparison, but I did not feel justified in having a greater number sent to me. From the table we see that Stewart, and apparently Eaton, took glabello-occipital length to the most posterior point on the occiput regardless of the mid-line. This could account for their somewhat greater means. The excess in Eaton's measurement of maximum breadth may be due to the fact that in one case, at least, he took this diameter across the supramastoid processes. In minimum frontal diameter Eaton apparently did not achieve a minimum. Both Stewart and Eaton follow Hrdlička in taking basion-nasion and basion-prosthion lengths to endobasion, whereas the writer takes basion to be the most inferior point in the mid-line on the anterior rim of the foramen magnum when the skull is in the Frankfort plane. Stewart, and probably Eaton, go off the mid-line to locate prosthion for basion-prosthion and external maxillary lengths. Stewart takes orbital breadth from lacrymale and also seems to take a more medial point for ectoconchion than the writer. Most of the other differences are

rather small, and are due to some technical differences that are not apparent.

The differences seen in table 2 have been used as compensations to render Stewart's and Eaton's series as comparable as possible to my own. MacCurdy's series remains uncorrected. Hereafter, therefore, my series will be considered as standard, and the means of Stewart's and Eaton's series will be adjusted to them. In so doing I do not mean to imply that their means are incorrect; they are simply different. The corrected means of all the series are given in table 6 at the end.

TABLE 2

Differences (mm.) in measuring techniques of Stewart and Eaton as against Newman.

MEASUREMENT OR INDEX	STEWART		EATON
	30 Males	30 Females	9 Females
Glabello-occipital length	+ .80	+ .67	+ 1.14
Maximum breadth	— .31	— .40	+ .67
Basion-bregma height	— .18	— .52	?
Minimum frontal diameter	+ .21	+ .13	+ .86
Basion-nasion length	+ 1.75	+ 1.69	+ 1.43
Basion-prosthion length	+ 2.94	+ 2.90	+ 2.67
Upper facial height	+ .12	— .06	?
Total facial breadth	+ .20	+ .47	?
Nasal height	— .14	— .38	+ .38
Nasal breadth	— .31	— .13	+ .14
Left orbital height	— .04	0	0
Left orbital breadth	— 1.37	— 1.45	— .50
External maxillary length	+ .93	+ 1.00	?
External maxillary breadth	+ .31	+ .62	?
Length-breadth index [1]	— .56	— .56	+ .79
Length-height index	— .34	— .58	+ .38
Breadth-height index	+ .09	— .11	+ .21
Mean height index	+ .48	— .19	+ .32
Cranial module	0	0	— .37
Upper facial index	0	+ .03	+ .11
Nasal index	— .49	+ .11	0
Left orbital index	+ 2.91	+ 3.53	— 1.13
External maxillary index	— 1.46	— 1.07	— 2.27

[1] Individually corrected indices were not calculated, but the mean differences in the component measurements were added or subtracted from an arbitrarily chosen mean. Then the mean indices were calculated. A question mark indicates insufficient numbers of measurements to yield a mean difference.

VARIABILITY

Now that these Peruvian series have been described and rendered comparable as regards deformation and metrical techniques, it will be of interest to examine their relative variability. For this purpose standard deviations have been calculated for all of the series, although it must be recognized that some of them are too small to yield reliable figures. Something in the nature of a standard of comparison is supplied by von Bonin and Morant's ('38) average standard deviations for various North American Indian series.

Table 3 shows the standard deviations of the nine Peruvian series and the "total" U. S. A. Indian series. The mean standard deviation of the "total" U. S. A. Indian series is 3.68, as against 3.75 for that of four Peruvian male series. Thus, taken collectively, these four series are, if anything, somewhat more variable than the North American group. Taken singly, only the San Damian males show a lower mean figure.

It is a common observation that female series exhibit a lower order of variability than male series from the same collections. This is borne out by the mean standard deviations given in table 3, where only the Machu Picchu females exceed the "total" U. S. A. Indian series.

When the standard deviations of individual measurements and indices are compared, it is found that the Peruvian series exceed the "total" U. S. A. Indian series in the following numbers:

MALES		FEMALES	
Chancay	7	Chancay	5
Miscellaneous Chicama	6	Miscellaneous Chicama	2
San Damian	0	San Damian	2
Paucarcancha	8	Paucarcancha	6
		Machu Picchu	7

The only excesses of great magnitude are in maximum breadth for the Machu Picchu females; length-breadth index for the Chancay and Miscellaneous Chicama males, and the Chancay and Machu Picchu females; and possibly left orbital index for the Chancay males, Machu Picchu females, and

TABLE 3

Standard deviations.

MEASUREMENT OR INDEX	MALE					FEMALE				
	"Total" U.S.A. Indian [1]	Chancay	Miscellaneous Chicama	San Damian	Paucarcancha	Chancay	Miscellaneous Chicama	San Damian	Paucarcancha	Machu Picchu
Glabello-occipital length	5.42	4.91	6.01	4.62	5.19	5.74	4.85	4.28	5.02	5.36
Maximum breadth	4.80	6.06	5.46	4.12	4.60	3.93	5.76	4.18	4.37	7.07
Basion-bregma height	4.68	4.49	4.63	4.03	5.47	3.54	4.35	4.56	5.14	4.87
Minimum frontal diameter	...	4.12	4.53	4.01	4.54	5.08	4.12	4.20	4.63	4.74
Basion-nasion length	3.69	3.85	3.94	3.69	4.21	2.70	2.79	3.29	3.56	3.93
Basion-prosthion length	4.57	4.94	4.98	4.10	4.73	3.96	3.57	3.74	3.94	3.80
Upper facial height	3.94	3.73	2.88	3.76	4.13	2.81	3.94	2.53	3.58	2.88
Total facial breadth	5.41	5.13	4.79	4.53	5.89	2.97	3.97	4.02	3.95	4.29
Nasal height	2.83	2.36	2.31	2.78	3.03	2.26	2.59	2.19	2.74	2.56
Nasal breadth	1.79	1.71	1.67	1.77	1.65	1.56	1.68	1.57	1.99	1.82
Left orbital height	1.67	1.77	1.65	1.54	1.49	1.52	1.56	1.81	1.78	1.99
Left orbital breadth	1.39	1.73	1.70	1.37	1.61	1.55	1.28	1.36	1.52	1.32
Exterior maxillary length	...	2.67	2.72	2.24	2.88	2.58	2.56	2.71	2.44	2.58
Exterior maxillary breadth	...	3.97	3.07	2.93	3.28	3.03	2.72	2.61	3.30	3.32
Length-breadth index	3.12	4.43	4.44	2.51	2.71	4.36	4.32	2.54	2.76	5.32
Length-height index	...	2.83	2.99	2.83	2.90	3.77	2.88	2.85	3.32	3.53
Breadth-height index	...	4.50	4.13	3.93	4.38	2.41	4.34	4.04	4.15	5.20
Mean height index	...	2.81	2.70	2.96	...	2.42	2.82	3.21	...	...
Cranial module	...	4.37	3.60	2.94	3.77	2.54	3.38	3.17	3.65	3.93
Upper facial index	...	2.56	2.45	2.98	3.08	2.13	3.06	2.18	1.97	2.68
Nasal index	•4.15	4.14	3.94	2.62	4.45	4.52	3.76	3.93	4.71	3.72
Left orbital index	4.05	5.50	4.21	3.94	5.14	4.19	3.74	4.78	5.22	5.62
Exterior maxillary index	...	8.24	6.10	6.41	7.12	5.96	6.18	7.45	5.76	6.03
Mean S.D. for 14 Meas. & Ind.	3.68	4.00	3.74	3.35	3.92	3.32	3.52	3.36	3.61	3.93
Mean S.D. for 22 Meas. & Ind.	...	3.91	3.76	3.24	3.87	3.26	3.47	3.20	3.59	3.90

[1] von Bonin and Morant '38.

Paucarcancha males and females. It was suggested previously (p. 24) that Eaton did not detect some of the cases of slight deformation in his series. This point, in addition to the equal presence of coastal and highland type crania in the series (see p. 36) should account for these high standard deviations in the Machu Picchu series. Both the Chancay and Miscellaneous Chicama male series consist of crania apparently free from deformation, but as I have stated, it is possible that the influence of indectectable deformation is present. Indeed, Stewart ('43), in analyzing his undeformed Miscellaneous Chicama males, felt that he achieved a better distribution curve for the length-breadth index by eliminating the fifteen putatively undeformed crania with highest indices. These fifteen crania he felt had the best chance of actually being slightly deformed. In addition, I thought I could detect a half-dozen or more skulls in the Chancay-Chillón collection that were more dolichoid and seemed morphologically distinct from the run of the series. Finally, it should be noted that the Chancay female series actually contains a number of slightly deformed crania, which fact should explain its much higher standard deviation for the length-breadth index.

Over and above these explanations for these extreme fluctuations in variability, it should be noted again that some of the series are too small to afford reliable standard deviations. The Chancay and Machu Picchu females are the smallest series used here, and therefore their standard deviations are suspect. The other series range over fifty in number, and hence should yield much more reliable figures. At best, however, an interpretation of table 3 is risky on methodological grounds.

I have shown that collectively and for the most part separately the Peruvian male series are somewhat more variable than the average North American Indian series as represented in the von Bonin and Morant figures. The influence of undetected deformation and the inclusion of different physical types are the best explanations for the higher variabilities in the Peruvian series. These explanations have equally valid

application in a comparison of the Peruvian series amongst themselves.

In this comparison, I again point out the strikingly low variability of the San Damian series, and the high variability of the Machu Picchu females. The remainder show intermediate variabilities, if we consider the Chancay female figures less reliable than those of the much larger Chancay male series. From a visual viewpoint the San Damian series varies remarkably little. In the Machu Picchu series, Eaton felt he could distinguish crania of coastal and highland "ancestry." The Chancay collection apparently houses a small minority of distinctive dolichoids. The same situation is quite possible for the Miscellaneous Chicama and Paucarcancha series. Furthermore, any of these series may not show two or more distinctive physical types, but nevertheless may have the elements of such well imbedded in their phenotype.

METRIC COMPARISON

In comparing the means of the Peruvian series, the x p.e. method has been used, the differences three or more times the probable error of the differences are considered statistically significant. The percentages of such significant differences, consistent for male and female series, permit the series to be ranked according to their degrees of relationship. The distributions of individual indices have also been considered, since the means themselves do not describe the dispersions.

In making these comparisons I have had in mind the following problems: (1) Are there definite coastal and highland physical types to be seen in Peruvian skeletal material, as claimed by Hrdlička ('14) and others? If there are such distinct types, is each consistent throughout its area, or are there intra-area differences of some magnitude? (2) Does this material furnish a justification for von Eickstedt's and Imbelloni's practice of combining the living Indian population of coast and highland under one physical type — the Andide or Pueblo-Andid? (3) What are the metric characteristics of the identi-

fiable physical types relative to variability and central tendency?

Table 4 shows those measurements and indices differing significantly between each pair of series and according to sex. In interpreting these differences, we shall disregard for the time being the Machu Picchu series. This series is a special problem, as has been pointed out already. In addition, since the Machu Picchu series is limited to females and part of the analysis depends upon checking significant differences in one sex as against those in the other, it has seemed desirable to relegate this series to a separate section.

A. Comparison of the north and central coast series with those from the central and south highlands

When the inter-series differences for the remaining series are totalled, the relationships can be ranked as indicated at the bottom of table 4. The most interesting feature of these ranks is that whereas the closest relationship is between the two coastal series (Chancay-Miscellaneous Chicama), the most distant one is to be seen in the highlands (San Damian-Paucarcancha). The next closest relationship is between those series most distant geographically — the Miscellaneous Chicama series of the north coast and the Paucarcancha series of the south highlands.

Although the differences between the four groups under consideration may be seen at a glance from table 4, it is desirable to summarize at least the differences in relative proportions, because these would seem to be the more significant. In so doing it must be remembered that compensation for inequalities of technique were made for the two coastal and the San Damian series, but no check is provided on techniques relative to the Paucarcancha group. Obviously then the last mentioned series may appear more different relative to the others than it actually is. Thus from the point of view of relative proportions alone, and according to rank, we have the following differences: (1) The Chancay series have higher

TABLE 4

Demonstration of the statistically significant (3 or more x p.e.) differences between the means of the Peruvian cranial series (except Machu Picchu).

MEASUREMENT OR INDEX	CHANCAY VS. MISCELLANEOUS CHICAMA Male	CHANCAY VS. MISCELLANEOUS CHICAMA Female	MISCELLANEOUS CHICAMA VS. SAN DAMIAN Male	MISCELLANEOUS CHICAMA VS. SAN DAMIAN Female	CHANCAY VS. SAN DAMIAN Male	CHANCAY VS. SAN DAMIAN Female	SAN DAMIAN VS. PAUCARCANCHA Male	SAN DAMIAN VS. PAUCARCANCHA Female	CHANCAY VS. PAUCARCANCHA Male	CHANCAY VS. PAUCARCANCHA Female	MISCELLANEOUS CHICAMA VS. PAUCARCANCHA Male	MISCELLANEOUS CHICAMA VS. PAUCARCANCHA Female
Glabello-occipital length		M.C.[1]		S.D.	**S.D.**	**S.D.**	P.		**P.**	**P.**	P.	
Maximum breadth							**S.D.**	**S.D.**	**C.**	**C.**	**M.C.**	**M.C.**
Basion-bregma height	**M.C.**	**M.C.**	**M.C.**	**M.C.**			**P.**	**P.**	**P.**	**P.**	P.	
Minimum frontal diameter				M.C.	**C.**	**C.**	**P.**	**P.**		C.		
Basion-nasion length		M.C.	**M.C.**	**M.C.**	**C.**	**C.**	**P.**	**P.**				
Basion prosthion length			**M.C.**	**M.C.**	**C.**	**C.**	**P.**	**P.**	C.			M.C.
Upper facial height	C.		S.D.				**S.D.**	**S.D.**	**C.**	**C.**		M.C.
Total facial breadth		C.[2]		M.C.		C.[2]		S.D.		C.[2]		M.C.
Nasal height	C.		S.D.				S.D.			C.		
Nasal breadth				M.C.								
Left orbital height	C.		S.D.	M.C.		C.	**P.**	**P.**	P.		P.	
Left orbital breadth		M.C.	**M.C.**	**M.C.**	**C.**	**C.**	**S.D.**	**S.D.**	**C.**	**C.**	**M.C.**	**M.C.**
Exterior maxillary length	C.			M.C.	**C.**	**C.**			C.		**M.C.**	**M.C.**
Exterior maxillary breadth	**C.**	**C.**			**C.**	**C.**			**C.**	C.	M.C.	
Length-breadth index			**M.C.**	**M.C.**		C.	**S.D.**	**S.D.**	**C.**	C.	**M.C.**	**M.C.**
Length-height index			**M.C.**	**M.C.**	**C.**	**C.**	**P.**	**P.**				
Breadth-height index		M.C.	**M.C.**	**M.C.**			**P.**	**P.**	**P.**	**P.**	**P.**	**P.**
Cranial module		M.C.		M.C.	**S.D.**	**S.D.**		S.D.	**P.**	**P.**		
Upper facial index	C.		**S.D.**	**S.D.**		S.D.	**S.D.**	**S.D.**	C.			
Nasal index	M.C.		M.C.				P.		P.	P.		
Left orbital index	**C.**	**C.**	**S.D.**	**S.D.**			**P.**	**P.**	**P.**	**P.**	**P.**	**P.**
Exterior maxillary index		C.		S.D.						C.		P.
Number of significant differences	9	9	13	17	9	12	16	15	15	14	10	10
Per cent of significant differences	40.9	40.9	59.1	77.3	40.9	54.6	72.7	68.2	68.2	63.6	45.4	45.4
Number of differences consistent in both sexes	3		9		9		13		11		6	
Rank	1		3		3		5		4		2	

[1] These letters are the initials of the series stated at the heads of the columns in which they occur. The presence of an initial opposite a measurement or index indicates that, according to sex, there is a significant difference favoring this series. Initials in boldface indicate consistent differences in the two sexes.

[2] The Chancay female series includes slightly deformed skulls, which may account in part for the greater face breadth here as compared with the male series. This has been omitted from the totals.

orbits than the Miscellaneous Chicama series; (2) the Paucarcancha series are more dolichocranic, higher vaulted, and have higher orbits than the Miscellaneous Chicama series; (3) the San Damian series, which rank equally with the Miscellaneous Chicama and Chancay series, are more dolichocranic, lower vaulted, and have longer faces and higher orbits than the former, and are larger and lower vaulted than the latter; (4) the Paucarcancha series are more dolichocranic, larger and higher vaulted, have shorter faces, wider nasal apertures, and higher orbits than the Chancay series; (5) the Paucarcancha series are more dolichocranic, higher vaulted, and have shorter faces and higher orbits than the San Damian series.

In the above comparison the Paucarcancha series stand out for possessing the relatively longest and highest vaults and highest orbits of all the groups. The San Damian series is notably low vaulted relative to the others. Because of the varied nature of the series themselves, these are the only cases in which the mean indices of one series exceed or are less than all the others. In checking upon the distributions of individual facial indices, it was found that, excepting the external maxillary index, all were quite consistent with the presence or absence of significant differences. In the external maxillary index, however, it became evident that the Miscellaneous Chicama series have a heavy scattering of relatively narrow palates (x — 115 interval; males 42%, females 53%), whereas the Chancay series show more relatively broad palates than any others (122 — x interval; males 54%, females 62%). The highland series are intermediate in this regard. The obvious reason why these differences are not expressed as statistically significant mean differences is that the ranges are great, the curves low. Thus the p.e.'s of the mean are sufficiently large to preclude x p.e.'s over 3. The Chancay-Chicama difference here should be added to the other differences noted above.

On the basis of these new data as well as the researches of Hrdlička ('14) it would seem that a large portion of the Peruvian coast housed essentially the same brachycranic

physical type. In the areas covered by the present series there is good evidence that this type had been there for some time (Stewart, '43; Newman, '43). It might well be called the coastal brachycephal, and can be metrically characterized as follows: sub-brachycranic, quite high-vaulted (hypsicranic by length-height, mostly metriocranic by breadth-height indices), high euryenic to low mesenic upper facial skeleton, mesorrhinic nasal aperture, meso- to low hypsiconchic orbits, and a brachyuranic palate. The crania are quite small in size, although usually far from gracile. The male stature was just about 160 cm. (Stewart, '43). A full description of the morphological attributes of Peruvian coast crania is given elsewhere (Newman, '43).

The two highland groups, on the other hand, differ in a number of metric features. As compared to the San Damian series, both sexes of the Paucarcancha group are significantly longer and higher vaulted, shorter in the upper face, and higher in the orbits. As may be noted in table 4, there are significant differences in the means of eight of the fourteen absolute measurements. The San Damian series is certainly not made up of the Paucarcancha physical type plus heavy coastal admixture. Hrdlička ('14) was convinced of the distinctiveness of this "oblong" type, which he saw in the Department of Huarochirí, as against the coastal round-head. I was particularly struck with a number of morphological differences in vault structure which I felt separated most San Damian crania from those of the coast. Particularly noteworthy is the low, rather pinched occiput so common in the San Damian collection and rarely seen on the coast. The low variability of this series further militates against the possibility of any considerable admixture. In short, the San Damian series must represent a distinct physical type from that of Paucarcancha.

The presence of two or more such types in the Peruvian highland is quite consistent with the terrain. Certainly until the Incas began moving whole coastal villages into the lower valleys of the sierra, there was relatively little population shift

as compared to the coast. Until more collections are studied it is impossible to determine whether the San Damian or the Paucarcancha physical type is the more typically highland, and I content myself with a summary description of each.

Metrically the physical type represented by the Paucarcancha series shows the following characteristics: on the average it is frankly dolichocranic and high vaulted (hypsicranic by the length-height, acrocranic by the breadth-height indices), and has a low mesene upper facial skeleton, a high mesorrhine to low chamaerrhine nasal aperture, highly hypsiconch orbits, and a brachyuranic palate. The photographs published by MacCurdy illustrate this physical type and in most cases demonstrate the low, pinched occiput, flat temporals, low frontal, high orbits, and rather low nasal root which seem characteristic as far as can be judged.

The San Damian physical type is mesocranic, medium in vault height (orthocranic by the length-height, metriocranic by the breadth-height indices), has a mesenic upper facial skeleton, a mesorrhinic nasal aperture, barely hypsiconchic orbits, and a brachyuranic palate. The characteristics dolichocranic features (ovoid contour, flat temporals, scaphocephaly, etc.) seen in most of the Paucarcancha photographs are largely lacking in the San Damian group.

B. The special problem of the Machu Picchu series

It has been noted that Eaton was able to distinguish about equal numbers of coastal and highland type crania in the Machu Picchu series. From an inspection of nine of these crania, I was able to see what Eaton had in mind; there are two quite distinct physical types in the collection. Eaton's burial descriptions indicate six males and twenty-eight females of the coastal type, and fourteen males and twenty-nine females of the highland type. The ranges as seen in the seriations for females of each type indicate that the physical assessments were made on morphological and not metric

grounds. The following are the means of the horizontal vault diameters and the length-breadth index for each type:

Comparison of coastal and highland type females from Machu Picchu.

MEASUREMENT (MM.) OR INDEX:	COASTAL TYPE Mean	HIGHLAND TYPE Mean
Glabello-occipital length	(21) 162.19	(12) 166.92
Maximum breadth	(21) 137.86	(11) 128.91
Length-breadth index	(21) 85.23	(11) 77.50

These differences are quite striking, although it may well be suspected that some of the coastal type crania were slightly deformed. A mean length-breadth index of 85 presupposes a range that runs into the low 90's. In this area at least, individual crania with indices over 90 may not be undeformed. Even if an allowance is made for slight deformation, the above differences are considerable. Unfortunately, the small size of the series does not permit seriations by physical type of the other measurements and indices.

According to table 5, the percentages of significant differences between the Machu Picchu females and those of the two other highland female series are very low. In fact the Machu Picchu-San Damian and Machu Picchu-Paucarcancha relationships are apparently as close as that between the two coastal series. It will be recalled, however, that the coastal relationship is based on consistent significant differences in both sexes, whereas any relationship involving the Machu Picchu series is based on females alone. Therefore, the Machu Picchu-San Damian and Machu Picchu-Paucarcancha relationships are actually not as close as the coastal one. Nevertheless I cannot adequately explain why the Machu Picchu females stand in close relationship to two such disparate series as those from San Damian and Paucarcancha. It is simpler to see why the Machu Picchu and the Chancay females show considerable affinity, since the former series houses about 50% coastal types.

We need not wonder how people of coastal ancestry reached the frontier citadel of Machu Picchu. This is easily ascribable to the mitmac system of the Incas. Relative to this, Means

('31, p. 345) states, "Thus it came about that most parts of Cuzco . . . contained many mitimaes [transferred people, colonists] from all parts of the [Inca] realm." He quotes Garcilaso (pp. 343–344) to the effect that, "The Inca [Pachacutec] took Indians from Nanazca (Nazca) and transported them to the banks of the river Apurimac . . ." Since Machu

TABLE 5

Demonstration of the statistically significant (3 or more x p.e.) differences between the means of the Machu Picchu and other female series.

MEASUREMENT (MM.) OR INDEX	SAN DAMIAN VS. MACHU PICCHU	PAUCARCANCHA VS. MACHU PICCHU	CHANCAY VS. MACHU PICCHU	MISCELLANEOUS CHICAMA VS. MACHU PICCHU
Glabello-occipital length	S.D.[1]	P.		M.C.
Maximum breadth		M.P.		
Basion-bregma height		P.		M.C.
Minimum frontal diameter			C.	M.C.
Basion-nasion length		P.	C.	M.C.
Basion prosthion length		P.	C.	M.C.
Upper facial height			C.	
Total facial breadth			C.[2]	M.C.
Nasal height			C.	
Nasal breadth				
Left orbital height	S.D.			
Left orbital breadth	S.D.		C.	M.C.
Exterior maxillary length			C.	M.C.
Exterior maxillary breadth	S.D.		C.	
Length-breadth index	M.P.	M.P.		
Length-height index			C.	
Breadth-height index		P.		M.C.
Cranial module	S.D.			M.C.
Upper facial index				M.P.
Nasal index				
Left orbital index	M.P.		M.P.	M.P.
Exterior maxillary index				
Number of significant differences	7	7	10	12
Per cent of significant differences	31.8	31.8	45.4	54.6

[1] These letters are the initials of the series stated at the heads of the columns in which they occur. The presence of an initial opposite a measurement or index indicates that there is a significant difference favoring this series.

[2] The Chancay female series includes slightly deformed skulls, which may account in part for the greater face breadth here. This has been omitted from the total.

Picchu was a very late site, the mitmac system must have been operating then at full power.

CONCLUSIONS

Let us now refer to the problems enumerated in the section on metrical comparisons. How do these new data fit in with Hrdlička's thesis of one coastal and one highland cranial type in Peru? It is apparent from the foregoing analysis that there seems to be a sub-brachycranic to brachycranic physical type which is consistent along the north and central coast. Hrdlička ('11) states that he has found this type from Pacasmayo in the north to at least Pisco in the south. Among others, von Eickstedt ('33) and Imbelloni ('38) have claimed a broad distribution for this type, and Imbelloni at least has related it with the Pueblo people of the southwestern United States. Stewart ('43) has critically examined this generalization, and quite correctly calls for more evidence, particularly skeletal data. Until more evidence is available, then, it is best to recognize this physical type seen in the Chicama and Chancay series as a Peruvian coastal type. It most probably has further connections to the north and south, but concrete demonstrations of such are lacking.

The findings of this report do not lend credence to Hrdlička's position that only one highland cranial type existed in Peru. Even in late times, it is evident that two such types were present. One is represented by the Paucarcancha collection from the upper Urubamba drainage; the other by the San Damian group in the Department of Huarochirí. As we have shown, the two series are distinctive in many ways.

MacCurdy ('23, pp. 287–288) attempted to link the most dolichocranic of the Paucarcancha crania with the Lagoa Santa type. He states that twenty-nine of the crania "with the Lagoa Santa range of cephalic index (as well as other characteristics) are present in the series and . . . they form a fairly homogeneous group." They could, he states, be considered duplicates of those reproduced by Rivet ('08) from Paltacalo, Ecuador. Rivet never published upon the bulk of

the Paltacalo series from which he arbitrarily selected those skulls with low cranial indices as representative of the Lagoa Santa type. Therefore, it is not certain whether he actually isolated a distinct physical type or merely cut off one end of the normal range of a fairly uniform group. I am also in no position to judge of the distinctiveness implied by MacCurdy relative to the twenty-nine ultradolichocranic skulls from the Paucarcancha collection. Be that as it may, the Paucarcancha series as a whole is frankly dolichocranic, and as such has no close parallel as far as is known in the Andean area. Von Eickstedt seemingly recognizes the distinctive position of the Paucarcancha series, since his map shows an isolated Lagide (derived from Lagoa Santa) group in that section of the Urubamba. The cultural materials in the caves at Paucarcancha seem to be Andean rather than Amazonian in character, but it must be noted that the Panoan-speaking Sipibo and Conebo were present along this section of the Urubamba in this century (Farabee, '22). The presence of non-Amazonian cultural traits such as trephination in the Paucarcancha and other caves does not by any means preclude an Amazonian origin of the physical type represented there.

The distribution of the San Damian physical type is not known outside of the Department of Huarochirí. Further exploration in the western sierra has not been made, but Hrdlička ('14) has noted minorities of the "oblong" (San Damian) cranial type in the coastal valleys between Chicama and Acari. If these minorities represent people who had come directly from sierra to coast, then this San Damian physical type may have had an extensive range in the western sierra.

Von Eickstedt ('33) and Imbelloni ('38) have considered the living Indians of the Peruvian coast and sierra as one physical type — the Andide or Pueblo-Andid. Since the Indian population of the coast has been amalgamating with other races ever since the Spanish Conquest, neither these writers nor anyone else is in a position to discuss its physical nature. To assume that the Indians who once inhabited the coast were identical with living Indians of the sierra is un-

warranted because somatological knowledge of the former is lacking. It does seem safe to assume, however, that the Late period Chicama and Chancay crania represent the late coastal population in general, just as the San Damian and Paucarcancha series can be identified with the living peoples of the sierra. If these assumptions are granted, then it is patent from the present findings that von Eickstedt's and Imbelloni's gross classifications for the Peruvian area at least merit subdivision.

SUMMARY

1. This study is based upon those Peruvian cranial series which, for the most part, satisfy the requirements of (a) proper archaeological documentation, (b) elimination of cranial deformation, and (c) comparability of measuring techniques. Relative to the last-mentioned requirement, an effort was made to compensate for such technical differences.

2. The series used are as follows: (a) Late period male and female series from the coastal valleys of Chancay and Chillon in central Peru (Newman, '43). (b) Miscellaneous (Early-Late period?) male and female series from the coastal valley of Chicama in northern Peru (Stewart, '43). (c) Late period male and female series from around the western sierran village of San Damian, Department of Huarochirí, in the central Peruvian highlands (U. S. National Museum series measured by the writer). (d) Late period (?) male and female series from a number of caves, such as that of Paucarcancha, along the Urubamba drainage in the southern Peruvian highlands (MacCurdy, '23). (e) Late period female series from caves surrounding the citadel of Machu Picchu in the southern Peruvian highlands (Eaton, '16).

3. On the average, these Peruvian series show, if anything, a slightly greater variability than the mean of the North American Indian series described in the Hrdlička catalogues. Taken separately, the San Damian series exhibit particularly low variability, while the Machu Picchu series is quite highly variable.

4. The high variability of the Machu Picchu series, coupled with Eaton's and my own impressions, indicate its composite nature. About half the series seems to be coastal and about half highland in ancestry.

5. Whereas Hrdlička was probably quite correct in ascribing one physical type to the Peruvian coast, there is no such consistency of type in the highlands during the Late period. The San Damian and Paucarcancha series differ markedly and thus represent two distinct highland strains.

6. Speculation as to the origins and relationships of the one coastal and two highland physical types is idle until more data are available. The putative identity of the coastal type with the southwestern U. S. A. Pueblo peoples, as suggested by von Eickstedt and Imbelloni, has been critically questioned by Stewart. In this report the identification of part of the Paucarcancha series with the Lagoa Santa type has been doubted.

7. The largely Late period cranial series upon which this report is based, should indicate that von Eickstedt and Imbelloni failed to make a proper distinction between the coastal and highland Indian populations of Peru. The terms "Andide" and "Pueblo-Andid" involve taxonomic conceptions too gross to fit the facts.

LITERATURE CITED

DORSEY, GEORGE A. 1898 A bibliography of the anthropology of Peru. Anthrop. Ser. Field Museum, vol. 2, no. 2, pp. 55–206.

EATON, GEORGE F. 1916 The collection of osteological material from Machu Picchu. Mem. Connecticut Acad. Arts and Sci., vol. 5, 96 pp.

FARABEE, WILLIAM CURTIS 1922 Indian tribes of eastern Peru. Papers Peabody Mus. Amer. Archeol. and Ethnol., Harvard Univ., vol. 10, 194 pp.

HOYOS SAINZ, L. DE 1923 Cráneos normales y deformados de los Andes (Perú). I. Mem. Soc. Esp. Antrop., año 2, pp. 151–184.

———— 1924 Same (Perú y Bolivia). II. Act. Soc. Esp. Antrop., año 3, pp. 3–37, 185–230.

HRDLIČKA, ALEŠ 1911 Some results of recent anthropological exploration in Peru. Smithsonian Misc. Coll., vol. 56, no. 16, 16 pp. (Also in Reseña Seg. Ses. XVII Cong. Intern. Amer., Mexico, 1912, pp. 72–88.)

HRDLIČKA, ALEŠ 1914 Anthropological work in Peru in 1913, with notes on the pathology of the ancient Peruvians. Smithsonian Misc. Coll., vol. 61, no. 18, 69 pp.

——— 1920 Anthropometry. Philadelphia.

——— 1939 Practical anthropometry. Philadelphia.

IMBELLONI, JOSÉ 1933 Los pueblos deformadores de los Andes. La deformación intencional de la cabeza, como arte y como elemento diagnóstico de las culturas. An. Mus. Nac. Hist. Nat. Buenos Aires, t. 37, no. 75, pp. 209–253.

——— 1938 Tabla clasificatoria de los Indios: regiones biológicas y grupos raciales humanos de América. Physis, vol. 12, no. 44, pp. 229–249.

KROEBER, A. L. 1926 Culture stratifications in Peru. Am. Anthrop., n.s., vol. 28, pp. 331–351.

MACCURDY, GEORGE GRANT 1923 Human skeletal remains from the highlands of Peru. Am. J. Phys. Anthrop., vol. 6, pp. 217–329.

MEANS, PHILIP AINSWORTH 1931 Ancient civilizations of the Andes. Charles Scribner's Sons, New York, 586 pp.

NEWMAN, MARSHALL T. 1943(?) Indian skeletal material from the central coast of Peru. An archaeologically oriented study in physical anthropology. (In Manuscript — to be published by the Peabody Museum, Harvard University.)

QUEVEDO A., SERGIO A. 1941–1942 Ensayos de antropología física. Los antíguos pobladores del Cuzco (Región de Calca). Rev. Mus. Nac., Lima, vol. 10, no. 2, pp. 282–309; vol. 11, no. 1, pp. 58–96.

RIVET, P. 1908 La race de Lagoa Santa chez les populations précolombiennes de l'Equateur. Bull. et Mem. Soc. Anthrop. Paris, 5th ser., vol. 9, fasc. 2, pp. 209–271.

STEWART, T. D. 1943 Skeletal remains with cultural associations from the Chicama, Moche, and Virú Valleys, Peru. Proc. U. S. Nat. Mus., vol. 93, pp. 153–185.

VON BONIN, GERHARDT, AND G. M. MORANT 1938 Indian races in the United States. A survey of previously published cranial measurements. Biometrika, vol. 30, pp. 94–129.

VON EICKSTEDT, E. F. 1933 Rassenkunde und Rassengeschichte der Menschheit. 5. Lieferung, pp. 577–736. Stuttgart.

TABLE 6

Means of undeformed Peruvian series: Male

MEASUREMENT OR INDEX	CHANCAY	MISCELLANEOUS CHICAMA [1]	SAN DAMIAN	PAUCARCANCHA
iabello-occipital length	(26)174.04 ± .65	(65)176.05 ± .50	(65)177.57 ± .39	(67)179.42 ± .43
Maximum breadth	(26)139.85 ± .80	(65)139.65 ± .46	(67)139.72 ± .34	(66)135.45 ± .38
Basion-bregma height	(26)132.58 ± .59	(63)135.31 ± .39	(66)132.20 ± .33	(67)137.07 ± .45
Minimum frontal diameter	(78) 92.92 ± .32	(66) 92.08 ± .31	(67) 90.75 ± .33	(62) 92.31 ± .39
Basion-nasion length	(25) 99.76 ± .52	(63) 98.49 ± .33	(66) 94.79 ± .31	(117) 98.56 ± .26
Basion-prosthion length	(22) 98.64 ± .71	(57) 97.06 ± .44	(53) 91.98 ± .38	(104) 96.13 ± .31
Upper facial height	(56) 71.64 ± .31	(57) 67.41 ± .26	(46) 71.98 ± .37	(100) 67.81 ± .28
Total facial breadth	(27)135.56 ± .67	(55)135.29 ± .44	(49)135.69 ± .44	(91)133.93 ± .42
Nasal height	(82) 50.75 ± .18	(65) 48.74 ± .19	(66) 50.29 ± .23	(112) 48.99 ± .19
Nasal breadth	(82) 24.04 ± .13	(63) 24.58 ± .14	(58) 24.02 ± .16	(112) 24.25 ± .10
Left orbital height	(82) 34.34 ± .13	(58) 33.57 ± .15	(61) 34.20 ± .12	(107) 34.92 ± .10
Left orbital breadth	(81) 39.51 ± .13	(59) 39.08 ± .15	(63) 38.17 ± .12	(108) 36.83 ± .10
Exterior maxillary length	(64) 54.62 ± .22	(54) 53.35 ± .25	(42) 52.57 ± .23	(92) 52.35 ± .20
Exterior maxillary breadth	(46) 66.00 ± .40	(46) 63.95 ± .30	(34) 63.44 ± .34	(78) 63.98 ± .25
Length-breadth index	(26) 80.32 ± .60	(65) 80.16 ± .37	(65) 78.87 ± .21	(66) 75.50 ± .22
Length-height index	(26) 76.19 ± .37	(59) 77.39 ± .26	(65) 74.56 ± .24	(67) 76.51 ± .24
Breadth-height index	(26) 95.16 ± .61	(59) 97.13 ± .36	(66) 94.68 ± .33	(66)101,21 ± .36
Mean height index	(26) 84.35 ± .37	(60) 86.35 ± .22	(63) 83.20 ± .25	
Cranial module	(58)148.07 ± .39	(62)149.51 ± .31	(65)149.91 ± .24	
Upper facial index	(64) 52.05 ± .22	(47) 49.83 ± .24	(43) 53.07 ± .31	(84) 50.74 ± .23
Nasal index	(82) 47.49 ± .31	(63) 50.55 ± .34	(60) 47.90 ± .23	(111) 49.63 ± .28
Left orbital index	(81) 88.18 ± .44	(64) 86.00 ± .36	(60) 89.43 ± .34	(106) 95.07 ± .34
Exterior maxillary index	(41)121.54 ± .87	(46)120.17 ± .61	(30)120.97 ± .79	(78)122.17 ± .54

[1] Means are corrected for differences in technique as shown in table 2.

TABLE 6 (continued)

Means of undcformed Peruvian series: Female

MEASUREMENT OR INDEX	CHANCAY [1]	MISCELLANEOUS CHICAMA [2]	SAN DAMIAN	PAUCARCANCHA	MACHU PICCHU [2]
Glabello-occipital length	(19) 162.58 ± .89	(58) 167.35 ± .43	(60) 169.63 ± .37	(36) 169.50 ± .56	(35) 162.89 ± .61
Maximum breadth	(19) 134.95 ± .61	(58) 136.24 ± .31	(60) 134.80 ± .36	(36) 130.42 ± .49	(35) 134.64 ± .81
Basion-bregma height	(18) 124.22 ± .56	(56) 129.29 ± .39	(57) 124.58 ± .41	(36) 128.56 ± .58	(35) 123.00 ± .56
Minimum frontal diameter	(26) 90.38 ± .67	(58) 88.82 ± .36	(61) 87.03 ± .36	(42) 87.33 ± .48	(38) 85.22 ± .52
Basion-nasion length	(30) 92.67 ± .33	(56) 94.13 ± .34	(57) 89.62 ± .29	(77) 93.52 ± .27	(37) 88.22 ± .44
Basion-prosthion length	(27) 93.18 ± .51	(49) 94.08 ± .38	(50) 88.48 ± .36	(66) 92.29 ± .33	(22) 87.24 ± .55
Upper facial height	(26) 66.08 ± .37	(50) 65.18 ± .38	(44) 65.20 ± .26	(55) 63.11 ± .23	(28) 64.07 ± .37
Total facial breadth	(29) 128.76 ± .37	(50) 126.83 ± .38	(53) 124.94 ± .37	(58) 123.03 ± .35	(24) 124.33 ± .59
Nasal height	(31) 47.16 ± .27	(54) 47.01 ± .24	(56) 46.50 ± .20	(74) 45.72 ± .22	(37) 45.86 ± .28
Nasal breadth	(30) 23.67 ± .19	(53) 23.73 ± .16	(56) 23.09 ± .14	(72) 23.46 ± .16	(37) 23.21 ± .20
Left orbital height	(31) 34.13 ± .18	(51) 33.79 ± .15	(57) 33.05 ± .16	(77) 34.19 ± .14	(32) 34.09 ± .24
Left orbital breadth	(31) 37.90 ± .19	(52) 38.64 ± .12	(58) 36.50 ± .16	(77) 35.09 ± .12	(31) 34.95 ± .16
Exterior maxillary length	(23) 51.30 ± .36	(47) 51.53 ± .25	(44) 49.73 ± .28	(61) 50.15 ± .21	(27) 48.59 ± .34
Exterior maxillary breadth	(18) 62.94 ± .48	(39) 59.99 ± .29	(35) 60.40 ± .30	(54) 59.83 ± .30	(23) 58.44 ± .47
Length-breadth index	(19) 83.10 ± .67	(58) 81.46 ± .38	(60) 79.45 ± .22	(36) 76.78 ± .31	(33) 83.31 ± .62
Length-height index	(18) 76.56 ± .60	(56) 77.13 ± .26	(57) 73.53 ± .25	(36) 75.94 ± .37	(32) 74.99 ± .42
Breadth-height index	(18) 91.94 ± .38	(56) 94.75 ± .39	(57) 92.60 ± .36	(36) 98.97 ± .47	(30) 91.36 ± .64
Mean height index	(18) 83.55 ± .37	(56) 85.46 ± .25	(57) 81.96 ± .29		
Cranial module	(18) 140.61 ± .40	(56) 144.19 ± .30	(57) 142.91 ± .28	(26) 142.73 ± .48	(30) 141.16 ± .48
Upper facial index	(24) 51.03 ± .29	(42) 50.66 ± .32	(39) 52.44 ± .24	(52) 51.15 ± .18	(15) 52.60 ± .47
Nasal index	(31) 50.03 ± .55	(53) 50.44 ± .35	(55) 50.09 ± .36	(71) 51.55 ± .38	(37) 50.32 ± .41
Left orbital index	(31) 90.00 ± .51	(53) 87.68 ± .35	(58) 90.62 ± .42	(75) 97.53 ± .41	(36) 94.13 ± .63
Exterior maxillary index	(16) 123.19 ± 1.00	(38) 116.89 ± .68	(34) 121.29 ± .86	(53) 119.38 ± .53	(21) 120.70 ± .89

[1] Includes a few slightly deformed skulls.

[2] Means are corrected for differences in technique as shown in table 2.

SKELETAL REMAINS FROM PARACAS, PERU

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ONE TEXT FIGURE AND ONE PLATE

One of the most important developments in Peruvian archeology was the discovery in 1925 by Tello and Lothrop of two sites on the Paracas Peninsula, 18 km. south of Pisco, representing one of the earliest coastal cultures. These sites, which are essentially cemeteries, are known as Cabeza Larga and Cerro Colorado. The latter apears to be the earlier and has received the most attention (Tello, '29; Tello and Williams, '30; Yacovleff and Muelle, '32). In speaking of the Cerro Colorado Tello and subsequent writers have made a distinction between the Caverns (man-made carafe-shaped pits) and the Grand Necropolis (subterranean house-like structures constructed of adobe bricks). From each of the Caverns, according to Tello ('29, p. 120), have been recovered upwards to forty human bodies, although Yacovleff and Muelle report a maximum of only five or six (incomplete and in great disorder) in the three caverns that they opened. At the Necropolis, on the other hand, Tello encountered 429 carefully wrapped mummies.

Thus far interest in these finds has centered largely in the textiles, often exquisitely embroidered, which constitute the mummy wrappings. It is chiefly on the basis of the weaving techniques and the embroidered designs in these textiles that a relative chronology is being worked out (cf. O'Neale, '42). "Kroeber tentatively places the Necropolis remains within the same time period as Early Nazca sites at Ica and Nazca

and with Primitive Supe. Tello holds that both cultures on the peninsula were contemporary with the Early culture at Chavín and earlier than any culture in the Nazca Valley so far known'' (O'Neale, '42, p. 145).

The importance of these finds from the standpoint of physical anthropology rests on the fact that they provide culturally identified skeletal remains; or in other words, remains from a single cultural period and one of the earliest thus far recognized on the coast. The significance of this fact becomes evident when it is considered that relatively few of the thousands of Peruvian skeletal remains in museums all over the world have cultural or chronological attributions (cf. Newman, pp. 21–45 in this number of the journal).

Rather scanty and in some respects, as will be pointed out later, conflicting morphological data have been published thus far concerning the Paracas skeletons. Hence, during my visit to Peru in 1941 I made a special effort to examine whatever Paracas skeletal material I could find.[1] Since almost all the skulls are deformed to an extreme degree, I doubted the value for comparative purposes of measurements taken thereon. For this reason I was content to note the type of deformity in the numerous skulls at the National Museum and the Archeological Museum of San Marcos University. However, at the Museum of Anthropology in Magdalena Vieja, a suburb of Lima, Dr. Julio Tello kindly permitted me to study a number of the unwrapped mummies from the Necropolis at Paracas. Here also I could examine the trephined and pathological specimens on public display. On the basis of these observations I shall attempt here to summarize and interpret wherever necessary or possible both the data in the literature and that which I obtained.[2]

[1] After my return Doctor Newman went to Peru under the auspices of the Institute of Andean Research with the intention of studying these Paracas remains more fully (see Strong, '42, p. 182). Subsequently he found that it would be more profitable to study the remains of the Chancay people (see p. 22 in this number of the journal.)

[2] Reports by Candela and Trotter on samples of tissue and hair from these same mummies appear elsewhere in this number of the journal.

MUMMIFICATION

The only published descriptions of Paracas mummies known to me are those by Tello ('29) and Yacovleff and Muelle ('32). Regarding the mummies from the Necropolis, Tello says (p. 131-5, freely translated):

> The manner in which the body has been assembled in the bundle is very peculiar. After extracting the viscera and a great part of the muscles the body has been subjected to a special mummifying treatment. At times the head has been removed from the body, the brain tissue being extracted through the foramen magnum. The thorax is opened nearly always across the sternum and the lungs and heart pulled out. The abdomen, likewise, is opened by means of a large longitudinal or transverse incision in order to extract the intestines and other viscera. In certain cases they have made incisions in the extremities so as to pull out the muscles. Accomplishing this operation the body is subjected to a process of mummification through the use of fire and perhaps various chemical substances, as judged by the smoked and still carbonized appearance that certain parts of the body present, and by the salty efflorescences of the chemical substances employed.
>
> Next the body was reduced to its minimum volume by means of forceful folding, in some cases of the extremities and of the vertebral column. When the body has not been decapitated, the markedly flexed head rests upon the abdomen, the markedly contracted inferior extremities lie on [se cruzan] the nape of the neck and the superior extremities on the chest. This peculiar tangled position has been maintained by means of strong bindings. . . .

Yacovleff and Muelle recovered from the Caverns only two mummies sufficiently well preserved to permit them to have an opinion on this matter. In these cases the intestines and their contents had not been removed. They conclude (p. 48, freely translated) that:

> . . . . to explain the preservation of these mummies it is not necessary to revert to an hypothesis involving fire and certain chemical materials because the physical conditions of the place suffice to impede the decomposition of organic material. Actually, it is difficult to find along the coast of Peru another site that combines to such a degree conditions contrary to the

process of putrification. The nearly complete absence of vegetation for 20 km. round about is due to the perpetual aridity; the saline wealth of the arid soil and of the ever-moving air comes from the deep sea; the relative altitude of the cemeteries above the possible filtration from their environs; the constant action of the solar rays; all this makes special treatment for the preservation of the bodies unnecessary. In La Puntilla we saw many perfect mummies of foxes (Canis Azarae, common in Paracas) whose bodies had been thrown on the sands by the hunters after skinning them. It should be pointed out also that the materials so well maintained in these conditions decompose as soon as transferred to Lima, to the extent that the flesh found admirably dry in the tomb did not remain so to the day following our return, but became a soft stinking mass.

My observations contribute very little to this picture, except as they supply certain checks on Doctor Tello's statements. Seeing these remains about 15 years after they had been removed to Lima and also many years after they had been unwrapped, they were, as might be expected, perfectly dry, but not in the same sense probably as when found. The tissues present seemed to represent chiefly skin, ligaments, tendons, and connective tissues. Muscle had disappeared almost entirely and no viscera could be identified. Hardened brain tissue was present in some skulls. Most of this remaining tissue was shredded and brittle and presented a difficult choice in the matter of sampling for blood group studies (cf. Candela, p. 65 in this number of the journal). Also, the mummies that I studied and cleaned up for measurement had been pretty well disarticulated previously, except generally the extremities, which were always tightly flexed at elbow and knee. It should be added that not uncommonly the bones were encrusted with a brittle black resinous substance, the nature of which could not be determined but which Doctor Tello believes to be "cooked" tissue. It will be recognized that the disarticulation of the body, the shredding of the tissues, the seeming absence of viscera, and the presence on the bones of a "resinous" substance, all are consistent with Doctor Tello's interpretation of the process of mummification quoted

above. Moreover, it should be borne in mind that the Necropolis burials may represent a later or different social class from those in the Caverns, and possibly received different treatment.

The best general summary of Peruvian mummies is that by Dawson ('28). This work, supplemented by that of Williams ('27) and the more recent account by Cornejo Bouroncle ('39) of Inca customs, makes it abundantly clear that the material so far reported is scanty and often incompletely described. For this reason it is impossible to get a clear picture of the distribution and variations of the practices. Nevertheless, it seems clear that artificial mummification with evisceration and other treatment was resorted to in some areas. In view of the ease with which mummies still can be obtained in Peru, the study of these problems will undoubtedly reward investigators.

DEFORMATION

Tello has characterized the almost ever-present deformity of Paracas skulls as "cuneiform," which can be interpreted either to mean parallelo-fronto-occipital flattening according to the classification of Gosse (1855), or the extreme grade of fronto-vertico-occipital flattening according to the classification of Imbelloni ('24–'25).[3] In contrast to this statement is that of Levellier ('28, p. 14) that "the skulls almost without exception show the Aimara [circular] type of deformation." Weiss ('32), on the other hand, interprets the deformation in most cases as parallelo-fronto-occipital ("tabular oblicua" of Imbelloni).

In truth, the type of deformity here is difficult to classify because it presents elements of all three of the types above mentioned. To characterize it best is perhaps to call it "pseudocircular." However, the clue to the understanding of this type seems to have been discovered by Yacovleff and Muelle ('32). I reproduce here (fig. 1) their figure 9 ('32,

[3] Yacovleff and Muelle ('32, pp. 48–49) seem to use the terms cuneiform and cylindrical synonomously.

p. 36) showing the skull of a child about 1 year of age with a deforming apparatus in place. This apparatus consists of a ring of cotton, 14 × 11 cm. in diameter (Weiss, '32, p. 93), applied to the occiput and posterior parietals and held in place by a band encircling the skull across the frontal bone. The fact that the pad at the back of the skull reaches so high perhaps has affected this part of the skull, for Weiss classifies the deformity in this case as "Brachicephalia artificiales erecta" (Imbelloni), which in later terminology ('33) is to say "tabular erecta" (fronto-vertico-occipital). It seems likely that the deformity of most adult skulls from Paracas (pl. 1) can be explained by this apparatus.[4]

Fig. 1 Sketch of a Paracas child's skull with deforming apparatus in place (Yacouleff and Muelle, '32, fig. 9).

Imbelloni ('33, p. 221) has stated that practically the whole coast of Peru yields deformed skulls that can be classified as "tabular erecta." Although this certainly holds for the north coast, I doubt that it is true for the south coast (cf. Stewart, '43); I believe that in the latter region there is a considerable element of what Imbelloni calls "tabular oblicua." In this connection, I was interested while in Peru to note the difference between the Paracas type of deformity and that present in skulls from the culturally related Nazca region (pl. 1). As a general rule deformed Nazca skulls are lower vaulted and show almost no signs laterally of a con-

[4] Two other adult Paracas skulls have been illustrated by the writer ('43, pl. 4).

stricting band. At the same time the posterior parts of the Nazca skulls are more rounded and often somewhat bilobed.

The flatness characteristic of the deformed Nazca skull occurs in extreme degree in the Cañete Valley on the south central coast, as Kroeber ('38, p. 267) has remarked. Such a shape could not occur in combination with a vertically flattened occiput, such as is to be seen, for example, in skulls from the Chicama Valley (cf. Stewart, '43, pls. 1 and 2). Indeed, almost every Peruvian valley has had a variant type of deformity and they cannot all be classed together. For this reason I regard Imbelloni's generalization quoted above as too sweeping.

TREPHINING

Trephine openings are another remarkable feature of the skulls from Cerro Colorado; they occur in nearly 40% (Tello, '29, p. 144) as compared to from 2 to 21% in various Andean populations (Muñiz and McGee, 1897, p. 14; Bandelier, '04, p. 440; MacCurdy, '23, p. 257; Quevedo, '41–'42, p. 84). Tello, who is also an authority on trephining as practiced in the highlands of Peru ('13), has given us the first account pointing out the peculiar type to be seen in the Paracas specimens. He says ('29, pp. 145–146, freely translated):

> Until now there have not been encountered [at Cerro Colorado] typical cases of cranial fractures, either depressed, comminuted or radiating, which are the principal motives that determine the trepanations in the Andean region. Many times the operation consists only in the careful removal by scraping of the external table and the diplöe [from sometimes half the skull cap], and keeping intact the inner table. No trace of pre- or post-operative periostitis or osteitis is perceived. If these skulls had not been found with the respective external medical applications [apositos] and had not presented clearly the regeneration of the bone, it would be possible to assume that the operations were performed postmortem.

Tello illustrates three of these cases ('29, figs. 99–101) as well as one of the less common circular incisions (figs. 102-103). The opening in the last mentioned case is located on the

frontal bone and as found was covered with a thin irregularly shaped sheet of gold.

I regret that I did not examine the trephined skulls more carefully than was possible through the glass of the museum cases at Magdalena Vieja and San Marcos, for of course no cases of trephining were included among the mummies in storage that I handled. It is my recollection, however, that few if any of the large trephine openings showed signs of healing, for in these cases you are aware chiefly of the size of the openings, the preservation of the thin inner table, and the fresh-looking scratches that indicate the technique employed. It was my impression that in these cases at least the openings could have been made postmortem.

It is most interesting to find such a high incidence of trephining along the coast at this early period. Elsewhere along the coast evidences of the custom are not common in any period; indeed, until this discovery the late highlands were regarded generally as the center for the custom (cf. MacCurdy, '23, p. 239). Incidentally, the absence at Paracas of quadrilateral openings by means of parallel incised lines, suggests a possible connection with the southern Peruvian highland and Bolivian areas rather than with the Huarochirí area of the central Peruvian highlands.

PATHOLOGY

The Paracas remains are perhaps best known to the physical anthropologists of this country through the description by Tello and Williams ('30; see also Williams, '32) of a few apparently syphilitic bones from here. These bones, it may be recalled, were found in part (left tibia, left humerus) at the bottom of the vestibule to cavern no. 5, and in part (skull, femora, left ulna) scattered about the mouth of the cavern. These scattered bones, believed to be from one individual, are attributed to the Paracas people on account of the finding of typical cultural objects scattered with them, and because the skull is said to be deformed in the manner of this group.

It is claimed by the authors that this is irrefutable evidence of the existence of syphilis in America in pre-Columbian times.

Anyone who has seen these bones must agree that they have all of the characteristics of syphilitic bones as we know the osseous manifestations of this disease. The only weakness in the argument seems to me to be the cultural and hence chronological association. In any continuously occupied region where the cemeteries are so obvious, as in Peru, the burials in these cemeteries are likely to represent late as well as early periods. Had the bones under discussion been found in the bottom of the cavern and wrapped as were the original burials, this indeed would have been incontestable evidence of antiquity. I would point out also that the deformity in this case is not altogether typical, and certainly not extreme.

It may be argued that such criticism is petty; that the chances fully favor antiquity in the case of a skeleton found under the combination of circumstances above enumerated. Nevertheless, as I have maintained before (Stewart, '40), it is equally petty to ignore the negative evidence. By negative evidence here I mean the relative infrequence of such pathological lesions in prehistoric Peruvian skeletal material as a whole. Hrdlička ('14, p. 62-5) pointed out this fact in his tabulation of lesions involving the long bones from Pachacamac and Chicama. As for the Páracas remains, we have no knowledge as yet as to the incidence of osteitis and periostitis in the collection as a whole. I can only add that the eleven male skeletons which I examined showed nothing of this nature.

PHYSICAL TYPE

Except for the few observations and indices on three adult crania given by Weïss ('32), no anthropometrical studies on Paracas remains have been published, and it has not been possible, therefore, to judge the physical relationships of this population with those of other parts of Peru. As indicated, also, the skulls are so deformed that it is difficult even to decide whether the various proportions of the face have been affected by this procedure.

My measurements extend to eleven skeletons, all but two of which have skulls; and in addition to three skulls without skeletons. These twelve skulls are deformed in the manner described above and are judged to be males. Three other skulls, with skeletons, that were measured have female characters and two of them (310/77, 421A) are deformed in the Nazca manner.[5] The measurements of these three specimens have been excluded from the present consideration. Because of the predominance of males in this collection, Doctor Tello is inclined to believe that the Necropolis was the burial place of members of a cult. There may thus be an element of selection in this assemblage.

TABLE 1

Comparison of Paracas deformed male skulls with those of other groups from Peru.

MEASUREMENTS (CM.) AND INDICES	PARACAS	CHAVIÑA [1]	SANTA LUCIA [1]	CHICAMA [1]
Diam. front. min.	(12) 85.4	(8) 88.6	(7) 88.8	(10) 94.6
Alv. pt.-nasion	(9) 75.8	(6) 71.8	(7) 76.0	(10) 70.1
Diam. biz. max.	(12) 136.2	(8) 139.1	(7) 135.1	(10) 140.8
Facial index, upper	(9) *55.6*	(6) *52.0*	(7) *56.3*	(10) *49.8*
Endobas.-prealv. pt.	(11) 100.5	(7) 98.4	(7) 97.6	(10) 97.8
Endobas.-subnas. pt.	(12) 89.5	(7) 87.0	(8) 86.1	(10) 85.9
Endobas.-nasion	(12) 99.4	(8) 97.4	(8) 98.4	(10) 96.3
Facial angle	(10) *67.0°*	(6) *66.5°*	(7) *67.0°*	(10) *68.0°*
Alveolar angle	(10) *53.5°*	(6) *53.2°*	(7) *55.0°*	(10) *51.0°*
Orbital ht. mean	(12) 36.1	(7) 35.3	(8) 35.4	(10) 34.6
Orbital br. mean	(12) 38.2	(7) 36.9	(8) 37.1	(10) 37.8
Orbital index mean	(12) *94.6*	(7) *95.8*	(8) *95.3*	(10) *92.1*
Nasal height	(12) 52.4	(7) 50.1	(8) 51.9	(10) 49.4
Nasal breadth	(12) 23.1	(7) 23.3	(8) 23.8	(10) 23.8
Nasal index	(12) *44.2*	(7) *46.5*	(8) *45.9*	(10) *48.3*
Upper alv. arch. length	(9) 56.1	(7) 54.0	(7) 54.6	(10) 53.5
Upper alv. arch. breadth	(9) 70.4	(4) 62.8	(7) 64.1	(8) 65.1
Upper alv. arch index	(9) *125.6*	(4) *117.9*	(7) *117.8*	(8) *122.3*

[1] From the collections of the U. S. National Museum. For localities see Hrdlička ('14).

Table 1 has been prepared to bring out the proportions (except the main vault diameters) of the average deformed

[5] Specimen no. 234 shows the typical Paracas deformity, but is definitely female. This is the only case in which I observed tattooing. Although the specimen was too incomplete to observe the pattern, it appeared to consist of pairs of dots and was observed on the arms and legs.

Paracas skull in comparison with three other deformed types from Peru: (1) The Chaviña type — somewhat like that of Paracas, but not always as extreme (see Hrdlička, '14, pl. 13); (2) the Santa Lucia type — circular; and (3) the Chicama type — fronto-vertico-occipital. Of these four types the greatest contrast is furnished by Paracas and Chicama from opposite ends of the Peruvian coast. Comparing the measurements of these two types, it will be seen that Paracas has a narrower forehead, relatively longer and narrower face, higher orbits, longer nose, and larger palate. The other two types are somewhat intermediate. Also, it should be noted that the average Paracas skull is larger than the others in the majority of its dimensions, which shows that the local name "cabeza larga" is warranted.

Although these metrical differences are consistent with the types of deformity represented, one cannot help wondering whether the broad facial features of the northern people and the narrow facial features of the southern people are thus wholly accounted for. Unfortunately, measurements on undeformed cranial series from the south coast, which might furnish an answer to this question, are not yet available. It may be noted in this connection that the relatively high orbits occurring in the southern highlands (see Newman, p. 44 in this number of the journal) depend on a decrease in the breadth rather than on a height increase.

Turning now to the long bones we are confronted by a somewhat different situation. Here the measurements are not altered by artificial shaping of the bones, but the comparative data are meager and are often based on bones that have been sexed individually from their morphological characters. Although skulls often have to be sexed in the same way, they present more reliable diagnostic characters.

Table 2 shows the measurements of the Paracas femora and tibiae in comparison with those of three other groups: (1) Pachacamac on the central coast, (2) Chicama on the north coast, and (3) Paucarcancha in the southern highlands. Of

TABLE 2

Comparison of Paracas male femora and tibiae with those of other groups from Peru.

MEASUREMENTS (CM.) AND INDICES		PARACAS	PACHACAMAC[1]	CHICAMA[1]	PAUCAR-CANCHA[2]
Femur:					
Lt. max.	R.	(10) 42.9	(500) 41.0	(200) 41.3	(52) 39.5
	L.	(10) 43.1	(500) 41.4	(200) 41.8	(48) 40.1
Lt. bicond.	R.	(10) 42.6	(500) 40.7	(200) 40.9	(52) 39.2
	L.	(10) 42.8	(500) 41.1	(200) 41.4	(48) 39.8
Diam. a.-p. at middle	R.	(10) 2.96	(500) 2.70	(200) 2.68	(52) 2.45
	L.	(10) 2.96	(500) 2.74	(200) 2.72	(48) 2.53
Diam. lat. at middle	R.	(10) 2.59	(500) 2.66	(200) 2.67	(52) 2.36
	L.	(10) 2.66	(500) 2.74	(200) 2.73	(48) 2.40
Index of shaft	R.	(10) *88.1*	(500) *98.5*[3]	(200) *99.6*[3]	(52) *96.3*[3]
	L.	(10) *90.3*	(500) *100.0*	(200) *100.4*	(48) *94.8*
Diam. max. upper flat	R.	(10) 3.26	(500) 3.31	(200) 3.28	(52) 3.07
	L.	(10) 3.29	(500) 3.34	(200) 3.31	(48) 3.10
Diam. min. upper flat	R.	(10) 2.34	(500) 2.28	(200) 2.28	(52) 2.00
	L.	(10) 2.42	(500) 2.30	(200) 2.31	(48) 2.02
Platymeric index	R.	(10) *71.8*	(500) *68.9*	(200) *69.6*	(52) *65.0*
	L.	(10) *73.6*	(500) *68.9*	(200) *69.7*	(48) *65.2*
Tibia:					
Lt. in position	R.	(91) 35.8	(218) 34.2	(218) 34.6	(30) 32.3
	L.	(11) 35.7	(215) 34.3	(204) 34.5	(26) 32.7
Diam. a.-p. at middle	R.	(10) 3.26	(218) 3.14	(218) 3.07	(29) 2.73
	L.	(11) 3.17	(215) 3.11	(204) 3.04	(24) 2.83
Diam. lat. at middle	R.	(10) 2.14	(218) 2.01	(218) 2.00	(29) 1.93
	L.	(11) 2.13	(215) 2.01	(204) 2.00	(24) 1.87
Index of shaft	R.	(10) *65.6*	(218) *64.1*	(218) *65.2*	(29) *70.5*
	L.	(11) *67.3*	(215) *64.4*	(204) *65.8*	(24) *66.0*

[1] Hrdlička ('38), and from ms.

[2] MacCurdy ('23). Several burial caves are represented of which Paucarcancha is the largest.

[3] Recalculated from the means according to the formula: Diam. lat./diam. a.-p. × 100.

these groups, the most contrasting are Paracas and Paucarcancha. As noted in connection with the skull, the Paracas bones generally are the largest. In shape of shaft the only notable difference is the more laterally flattened midshaft of the femur in the Paracas group. This shape of shaft might be associated with function or a greater muscular strength in the Paracas group.

The average dimensions of the other long bones from Paracas, for which the comparative data are too few to warrant giving, are listed in table 3.

TABLE 3

Mean dimensions of the other long bones of the Paracas males.

	HUMERUS				RADIUS:	ULNA:	CLAVICLE:	FIBULA:
	Lt. max.	Diam. max. at mid.	Diam. min. at mid.	Index of shaft	MAX. LT.	MAX. LT.	MAX. LT.	MAX. LT.
R.	(10)30.8	(10)2.24	(10)1.62	(10)*73.0*	(9)23.3	(9)24.8	(9)15.8	(9)35.0
L.	(10)30.2	(10)2.06	(10)1.58	(10)*77.2*	(9)23.3	(9)24.9	(8)15.2	(8)35.2

It appears hence that the Paracas group differs from the Peruvian skeletal remains thus far studied, particularly in general size (male stature according to Pearson's formula *e* is 161.8 cm.) and in the narrowness of the facial features. As I have pointed out, however, this may be a selected group of large males and not typical of the population as a whole. Also, the type and degree of deformity may have altered the dimensions of the face. Therefore, until larger and more representative collections have been studied, too much significance should not be attached to these findings.

SUMMARY

Published descriptions and the writer's own observations on the Paracas mummies are summarized under five headings: (1) Mummification, (2) deformation, (3) trephining, (4) pathology, and (5) physical type. It is pointed out that these mummies show certain physical characters, for the most part artificial in nature, that distinguish them from other known

Peruvian groups. Until a larger and more representative Paracas sample is studied, and until more data on neighboring groups are available, it will be impossible to interpret the relationships in this part of Peru.

LITERATURE CITED

BANDELIER, ADOLPH F. 1904 Aboriginal trephining in Bolivia. Am. Anthrop., n.s., vol. 6, pp. 440–446.

CANDELA, P. B. 1943 Blood group tests on the tissues of the Paracas mummies. Am. J. Phys. Anthrop., n.s., vol. 1, pp. 65–67.

CORNEJO BOURONCLE, JORGE 1939 Las momias Incas. Trepanaciones craneanas en el antiguo Perú. Bol. Mus. Hist. Nat., Lima, año 3, no. 11, pp. 106–115.

DAWSON, WARREN R. 1928 Mummification in Australia and in America. J. Roy. Anthrop. Inst., Gr. Brit. and Ire., vol. 58, pp. 115–138.

GOSSE, L.-A. 1855 Essai sur les déformations artificielles du crâne. An. Hyg. Publ. et Méd. Lég., 2nd ser., tome 3, pp. 317–393.

HRDLIČKA, ALEŠ 1914 Anthropological work in Peru in 1913, with notes on the pathology of the ancient Peruvians. Smithsonian Misc. Coll., vol. 61, no. 18, 69 p.

——— 1938 The femur of the old Peruvians. Am. J. Phys. Anthrop., vol. 23, no. 4, pp. 421–462.

IMBELLONI, JOSÉ 1924–1925 Estudios de morfología exacta: Parte III. Deformaciones intencionales del cráneo en Sud América. Polígonos Craneanos Aberrantes (serie A). Rev. Mus. La Plata, vol. 28 (3rd ser., tomo IV), pp. 329–407.

——— 1933 Los Pueblos deformadores de los Andes. La deformación intencional de la cabeza, como arte y como elemento diagnóstico de las culturas. An. Mus. Nac. Hist. Nat. Buenos Aires, tomo 37, no. 75, pp. 209–253.

KROEBER, A. L. 1938 Archeological explorations in Peru. IV. Cañete Valley. Appendix 5: Measurements of skulls. Field Mus. Nat. Hist., Anthrop. Mem., vol. 2, no. 4 (1937), pp. 266–267.

LEVILLIER, JEAN 1928 Paracas. A contribution to the study of pre-Incaic textiles in ancient Peru. Paris, 37 p.

MACCURDY, GEORGE GRANT 1923 Human skeletal remains from the highlands of Peru. Am. J. Phys. Anthrop., vol. 6, pp. 217–329.

MUÑIZ, MANUEL ANTONIO, AND W. J. MCGEE 1897 Primitive trephining in Peru. 16th Ann. Rep. Bur. Am. Ethnol., pp. 3–72.

NEWMAN, MARSHALL T. 1943 A metric study of undeformed Indian crania from Peru. Am. J. Phys. Anthrop., n.s., vol. 1, pp. 21–45.

O'NEALE, LILA M. 1942 Textile periods in ancient Peru: II. Paracas caverns and the Grand Necropolis. Univ. Calif. Pub. Am. Arch. Ethnol., vol. 39, no. 2, pp. 143–202.

PEARSON, KARL 1898 On the reconstruction of the stature of prehistoric races. Phil. Trans. Roy. Soc., ser. A, vol. 192, pp. 169–244.

QUEVEDO A., SERGIO A. 1941–1942 Ensayos de antropología física. Los antíguos pobladores del Cuzco (Región de Calca). Rev. Mus. Nac., Lima, vol. 10, no. 2, pp. 282–309; vol. 11, no. 1, pp. 58–96.

STEWART, T. D. 1940 Some historical implications of physical anthropology in North America. Essays in historical anthropology of North America, published in honor of John R. Swanton. Smithsonian Misc. Coll., vol. 100, pp. 15–50.

——— 1943 Skeletal remains with cultural associations from the Chicama, Moche, and Virú Valleys, Peru. Proc. U. S. Nat. Mus., vol. 93, pp. 153–185.

STRONG, WM. DUNCAN 1942 Recent archeological research in Latin America. Science, vol. 95, no. 2460, pp. 179–183.

TELLO, JULIO C. 1913 Prehistoric trephining among the Yauyos of Peru. Proc. 18th Ses. Intern. Cong. Americanists (London, 1912), pt. 1, sec. 2, pp. 75–83.

——— 1929 Antiguo Peru; Primera epoca. Editado por la Comisión Organizadora del Segundo Congreso Sudamericano de Turismo, Lima, 168 p.

TELLO, JULIO C., AND HERBERT U. WILLIAMS 1930 An ancient syphilitic skull from Paracas in Peru. Ann. Med. Hist., n.s., vol. 2, pp. 515–529.

TROTTER, MILDRED 1943 Hair from Paracas Indian Mummies. Am. J. Phys. Anthrop., n.s., vol. 1, pp. 69–75.

WILLIAMS, HERBERT U. 1927 Gross and microscopic anatomy of two Peruvian mummies. Arch. Path. and Lab. Med., vol. 4, pp. 26–33.

——— 1932 The origin and antiquity of syphilis: The evidence from diseased bones. A review, with some new material from America. Arch. Path., vol. 13, pp. 779–814, 931–983.

WEISS, P. 1932 Restos humanos de Cerro Colorado [Cavernas, Paracas]. Rev. Mus. Nac. Lima, no. 2, pp. 90–102.

YACOVLEFF, E., AND J. C. MUELLE 1932 Una exploracion en Cerro Colorado [Cavernas, Paracas]. Rev. Mus. Nac. Lima, no. 2, pp. 31–59.

PLATE 1

EXPLANATION OF FIGURES

The skull on the left, shown in side and top views, is Field Museum No. 170367 from Cabeza Larga. (Photographs through the courtesy of Dr. A. L. Kroeber.) The skull on the right, likewise shown in side and top views, is U. S. N. M. No. 293275, from Coyungo (about 40 miles west of Nazca). These two skulls show the essential differences between the Paracas and Nazca types of deformity.

BLOOD GROUP TESTS ON TISSUES OF PARACAS MUMMIES

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Through the courtesy of Dr. T. D. Stewart the writer has had the opportunity of testing fifteen tissue samples derived from fourteen Paracas mummies. Doctor Stewart secured these samples in the course of his examination of the mummies at the Museo de Anthropologiá in Magdalena Vieja, a suburb of Lima, Peru. The collector's numbers of these individuals are as follows: 38, 94, 157, 190 (2), 234, 243, 251, 253, 290, 310, 310-77, 382, 392, and 421 [1]

Although the tissue samples were tested both in the ground-up dry state and in the form of aqueous extracts and, although the testing serums were used over a wide range of dilutions, no dependable or reproducible reactions were obtained.

There are three possible explanations for this failure. The first arises from the presence in most of the tissues of some gummy, resinous material,[2] serving perhaps as a preservative. This substance was particularly evident in the extracts produced by means of boiling water, and it rendered the performance of the tests by this method almost impossible. It is unfortunate that such was the case, since aqueous extracts prepared according to the method of Schiff (Wiener, '39) appear to offer more promise than the pulverized muscle itself. The writer has succeeded in obtaining a strong reaction for group B from an aqueous extract of the muscle tissue of an

[1] For further description of this material see Stewart in this issue.

[2] There was not enough of this material left after testing for blood groups to permit analysis and definite identification.

Egyptian of the Eleventh Dynasty (c. 2000 B.C.), after having failed in an attempt to determine the blood group from the dry ground-up muscle (Candela, '41). It is possible, therefore, that the blood group factors may have been present in the Paracas material, but were unidentifiable by reason of the presence of the resinous substance.

Secondly, the Peruvians represented by the Paracas material may actually have possessed the group A and/or the group B factors, but these may have disappeared from the material through deterioration. Such was the case in the instance of the Aleutian mummies tested through the courtesy of Dr. Aleš Hrdlička. After having failed to obtain reactions from the muscle tissue, the writer was able to blood-group successfully thirty of those mummies by means of tests upon their bone marrow (Candela, '39).

The third possibility is that these ancient Peruvians may all have belonged to group O. In this connection, it may be of interest to note briefly the serological characteristics of the modern Peruvian Indians. Boyd's tables of blood group distributions list three series (Boyd, '39). One of these consists of 200 pure-blood natives, and in these group O is present in 100%. In a second series of 1372 "mixed" natives, group O was present in 75.1%. In a short series from Huancabamba and Perico, there was somewhat more A and B, and here group O was present in 55.6%. To these three series may be added a new series of natives obtained at the hospital of Milluachaqui, in the Department of Libertad. In this series group O was present in from 79 to 83% (Larreta, '41).

Thus the only available series of pure-blood Peruvian Indians is completely lacking in A and B. Two of the remaining three series have such small amounts of group A and B that European admixture may be presumed. Only in the series from Huancabamba and Perico are the proportions of A and B large enough to demand a consideration of the presence of these factors in the indigenous population. Since Boyd and Boyd ('37) tested mummy tissue from 134 ancient Peruvians, and obtained one reaction for group A and six for group B,

it may be that some of the Peruvian peoples possessed these factors in rather large proportions. On the other hand, if the three first-mentioned series are more representative of the ethnic stock to which the Paracas individuals belonged, then it is possible that the latter may have possessed only the O factor.

Since the reliability of blood group reactions obtained from cancellous bone has been established (Candela, '40), it is hoped that the opportunity will arise to conduct such tests upon the bones of the Paracas mummies.

LITERATURE CITED

BOYD, W. C. 1939 Blood groups. Tabulae Biologicae, vol. 17, p. 113.

BOYD, W. C., AND L. G. BOYD 1937 Blood grouping tests on 300 mummies. J. Immunol., vol. 32, p. 307.

CANDELA, P. B. 1939 Blood-group determinations upon the bones of thirty Aleutian mummies. Am. J. Phys. Anthrop., vol. 24, p. 361.

——— 1940 Reliability of blood-group tests on human bones. Am. J. Phys. Anthrop., vol. 27, p. 365.

——— 1941 The blood-grouping of Wah. Sci. News Letter, vol. 39, p. 105.

LARRETA, J. A. 1941 Caracteristicas serológicas de la primera infancía en niños peruanos nativos de los Andes. Cron. Med., vol. 58, p. 1929.

WIENER, A. S. 1939 Blood Groups and Blood Transfusion. Charles C. Thomas, Springfield, Ill. (2nd ed.).

HAIR FROM PARACAS INDIAN MUMMIES

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TWO FIGURES

During his visit to Peru in 1941 Dr. T. D. Stewart examined a small series of Paracas Indian mummies collected by Dr. Julio C. Tello in 1925.[1] These mummies are preserved in the Museo de Antropología at Magdalena Vieja, a suburb of Lima, and are identified as yet only by the collector's numbers. In connection with his examination Doctor Stewart secured pieces of scalp from ten of the mummies. These hair samples form the basis of the present report.

Examination of hair from mummies is not a new field of study. Peter Browne (1853) who first suggested a correlation between race and the shape of the cross section of hair may have included hair from mummies among his material. In a contribution made later (1860) to a collective study on the American Indian, Browne examined hair from ten individuals of whom six were mummies. Woodbury and Woodbury ('32) studied differences between certain of the North American Indian tribes; of these, two were prehistoric tribes, viz., the Basket Maker and Mesa Verde Indians.

The present series is comprised of two females (234 and 310-77) and eight males; one individual in each group had been classified as "young" (38 and 310-77) and there was some evidence that the others were old since the sample in each case was interspersed with very light yellow hairs which may be assumed to have been white. In general, the color was a rusty brown and gave the appearance of having faded.

[1] Doctor Stewart's findings are given on pages 47–64 of this number of the Journal.

These hairs fluoresced; the lightish or yellowish ones more brilliantly than the darker hairs (Figge, '42). In all cases the hairs were extremely brittle and had to be handled with greatest care. With one exception, the samples were generous, consisting of pieces of scalp with diameters of approximately 4 or 5 cm. bearing hairs which in half the cases including the females were as long as 20 cm. or more, and very much shorter in the remainder. In all samples the hair had cut ends. There was no indication of, and no way was found to determine, the region of the head from which the samples were taken. The hair of mummies 94 and 310 was quite definitely wavy; that of the others appeared to be straight.

The determination of shape and size of the hair shaft may be made on the cross section of the shaft. It was found that these fragile hairs could be sectioned transversely with the Hardy device. This instrument has been described by Doctor Hardy ('35) and its application to the study of human hair was made by Steggerda ('40). The procedure used on the hairs from the Paracas mummies was as follows: a lock of the hair was cut at a distance of approximately ½–1 cm. from the scalp; washed in ether-alcohol and allowed to dry; sectioned transversely near the proximal end with the aid of the Hardy device; and mounted on a slide in Canada Balsam.

The slide was projected onto a sheet of "Kodaloid." This is a celluloid-composition material whose weight-area ratio is known and has been used before in the study of hair (Trotter, '30). The projection was made from an inverted microscope at a distance which produced a magnification of 355x. The outlines of the cross sections of the hairs were drawn on the Kodaloid and the scale from a slide micrometer was projected at the same distance. Thus, the measurement of the diameters of the hairs could be made directly by means of the projected scale. Finally the cross section outlines were cut out and weighed and the area equivalent to the weight was determined.

On each slide the entire number of cross sections was considered and all, with the exception of number 243, afforded a

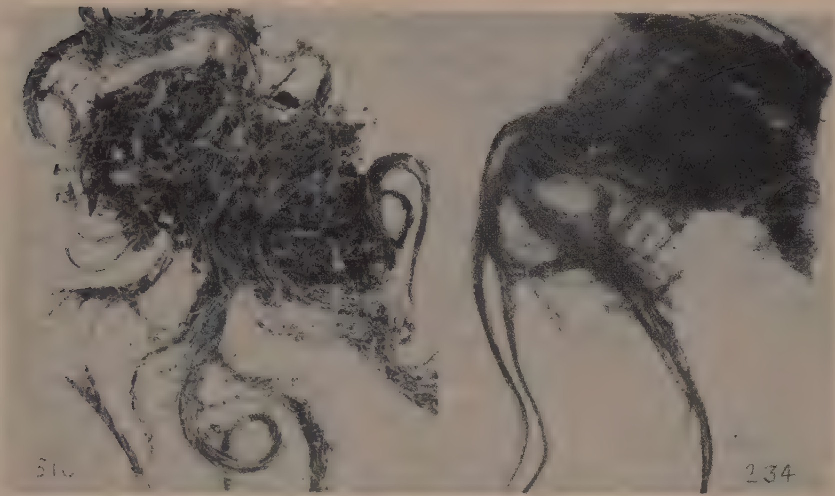

Fig. 1 Photographs of hair samples from Paracas mummies, number 234 and number 310, showing on the one hand hair which is relatively straight and, on the other, hair which is definitely wavy. Magnification approximately $\times \frac{3}{4}$.

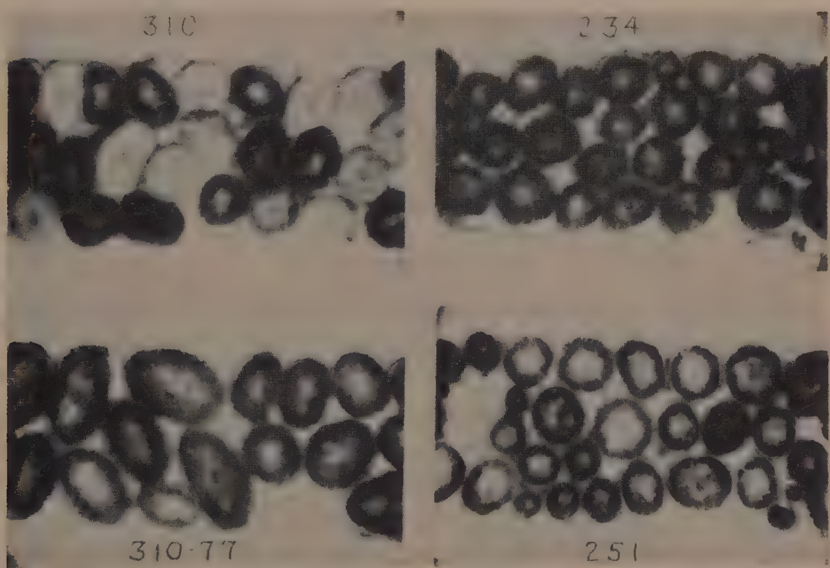

Fig. 2 Cross sections of hair from four Paracas mummies, numbers 234, 251, 310 and 310-77, showing variations in size and shape. Magnification approximately $\times$ 100.

reasonable number for statistical consideration. It has been assumed that these mummies are all from one racial stock, therefore this analysis must necessarily be one of individual variation from an intraracial standpoint.

FORM

The means for the indices $\left(\frac{\text{smallest diameter} \times 100}{\text{greatest diameter}}\right)$ of the ten samples in the series shown in table 1 indicate a range of 16 points, viz., from 70 to 86. This spread covers all divisions of hair form according to Martin ('28) who considered hair with an index of 50–75 to be curly; 75–80 wavy; and 80–100 to be straight. It is of interest that two samples (94 and 310) were wavy, if not curly, in the gross specimen and that two other samples, whose indices were even lower (392 and 310-77) appeared to be straight. The range of means for the indices of ten Negroes found by Steggerda and Seibert ('41) amounted to 17 points.

However, the hair of the total group of Paracas mummies shows a mean of 81.81 for the index which stands midway between Woodbury and Woodbury's findings for the Mesa Verde Indians of 79.77 and for the Basket Maker Indians of 82.81. It is within the range of indices reported by Steggerda and Seibert for the Maya, Hopi, Navajo and Zuni Indians (85.04, 82.98, 82.53, 80.46, respectively).

AREA

The means of the areas of the cross sections of these hairs are recorded in square millimeters in table 2.

The range of the means is wide (.002049–.004740). The square units by which Steggerda and Seibert ('41) have expressed cross section area may be compared directly with the present table by moving the decimal points in their tables four places to the left. Thus, Steggerda and Seibert found a range between the individual Negroes of .002254 sq.mm. (.002845–.005096); these Paracas mummies show a range of .002691. The mean of the cross section areas of the hairs from all these ten mummies is only .002910 sq.mm. or approxi-

mately 30% less than the average mean areas found for the four Indian tribes by Steggerda and Seibert and for the adult French Canadians (.00325–.00423 sq.mm.) by Trotter and Dawson ('34).

Woodbury and Woodbury ('32) followed the suggestion of Martin ('28) and determined the texture of hair by the formula of $\frac{\text{greatest} + \text{least diameters}}{2}$.

TABLE 1

Mean indices of the hair of Paracas mummies.

INDIVIDUAL	NO. HAIRS	MEAN	S.D.	C.V.
38	118	84.04 ± .66	10.64 ± .47	12.66 ± .56
94	77	78.66 ± .92	11.88 ± .65	15.10 ± .82
190	89	82.61 ± .82	11.40 ± .58	13.80 ± .70
234	141	85.58 ± .58	10.27 ± .41	12.00 ± .48
243	15	80.10 ± 2.04	11.74 ± 1.45	14.65 ± 1.80
251	163	85.60 ± .49	9.34 ± .35	10.91 ± .41
310	61	77.65 ± .92	10.71 ± .65	13.79 ± .84
382	133	85.09 ± .69	11.72 ± .48	13.77 ± .57
392	75	76.42 ± .89	11.46 ± .63	15.00 ± .83
310-77	83	69.83 ± 1.07	14.50 ± .76	20.77 ± 1.09
Total	955	81.81 ± .27	12.19 ± .19	14.90 ± .23

TABLE 2

Mean areas (in square millimeters) of the cross sections of the hair of Paracas mummies.

INDIVIDUAL	NO. HAIRS	MEAN	S.D.	C.V.
38	118	.002981 ± .000038	.000617 ± .000027	20.70 ± .91
94	77	.002607 ± .000064	.000826 ± .000045	31.69 ± 1.72
190	89	.002864 ± .000075	.001052 ± .000053	36.71 ± 1.86
234	141	.002339 ± .000035	.000611 ± .000025	26.13 ± 1.05
243	15	.004358 ± .000175	.001004 ± .000124	23.03 ± 2.84
251	163	.002049 ± .000044	.000837 ± .000031	40.85 ± 1.53
310	61	.002966 ± .000050	.000576 ± .000035	19.43 ± 1.19
382	133	.002437 ± .000040	.000676 ± .000028	27.74 ± 1.15
392	75	.004582 ± .000106	.001362 ± .000075	29.72 ± 1.64
310-77	83	.004740 ± .000114	.001534 ± .000269	32.37 ± 1.69
Total	955	.002910 ± .0000275	.001259 ± .0000194	43.26 ± .67

It has been pointed out (Trotter, '30) that the cross section area is a more critical evaluation of hair texture than the computation of Martin, but for the purpose of comparison with the Woodburys' report on prehistoric Indian tribes the average texture of the hair of each of the Paracas mummies was computed in millimeters. They are as follows:

INDIVIDUAL	TEXTURE IN MILLIMETERS	INDIVIDUAL	TEXTURE IN MILLIMETERS
38	.06419	251	.05333
94	.06188	310	.06594
190	.06421	382	.05840
234	.05796	392	.08153
243	.07667	310-77	.07780

Woodbury and Woodbury ('32) found the mean texture of the hair of the Basket Maker Indians to be .08343 mm. and of the Mesa Verde Indians to be .08660 mm.

The hair under examination is small in cross sectional area when compared with hair of both modern and prehistoric Indian tribes and of French Canadians; on the other hand it is larger than the cross section area which Steggerda and Seibert ('41) found for the Dutch (.002250 sq.mm.). The dehydration involved in the process of mummification may have had an appreciable effect on the size of the hair. There is evidence that hair loses some weight after dehydration (Trotter, '36) and such a loss might conceivably be accompanied by a diminution in the cross sectional area of the hair.

SEX DIFFERENCE

The mean indices for the hair of the two females in the group consisted of the lowest and the next to the highest index. Likewise, the mean cross section area was for the female with the high index next to the smallest of the entire group and for the female with the low index the lowest of all the cross section areas. No sex difference is suggested by these extremes.

SUMMARY

The form and size of the hair of ten Paracas mummies showed wide variation. In general, the hair section was

circular and therefore compared favorably with other determinations on both prehistoric and modern Indian hair. The size of the hair was much smaller than has been found for other Indians, but not so small as has been recorded for at least one white racial group. Finally, it should be noted again that along with the small number of individuals in the series there may have been a discrepancy in the part of the scalp from which the samples were derived and that the process of mummification may have reduced the size of the hair.

LITERATURE CITED

Browne, Peter 1853 Trichologia Mammalia. Philadelphia.

——— 1860 Examination and description of the hair of the head of the North American Indian. In H. R. Schoolcrafts' Archives of Aboriginal Knowledge, vol. 3, pp. 375–393.

Figge, Frank H. J. 1942 Near-ultraviolet rays and fluorescence phenomena as aids to discovery and diagnosis in medicine. Bull. of School of Med., U. of Maryland, vol. 26, pp. 165–177.

Hardy, J. I. 1935 A practical laboratory method of making thin cross-sections of fibers. Circular 378, U. S. Dept. Agric., Washington, D. C.

Martin, Rudolph 1928 Lehrbuch der Anthropologie. Jena.

Steggerda, Morris 1940 Cross-sections of human hair from four racial groups. J. Heredity, vol. 31, pp. 475–476.

Steggerda, Morris, and Henri C. Seibert 1941 Size and shape of head hair from six racial groups. J. Heredity, vol. 32, pp. 315–319.

Trotter, Mildred 1930 The form, size, and color of head hair in American Whites. Am. J. Phys. Anthrop., vol. 14, pp. 433–446.

——— 1936 The hair of the Arabs of central Iraq. Am. J. Phys. Anthrop., vol. 21, pp. 423–429.

Trotter, Mildred, and Helen L. Dawson 1934 The hair of French Canadians. Am. J. Phys. Anthrop., vol. 18, pp. 443–457.

Woodbury, George, and Edna T. Woodbury 1932 Differences between certain of the North American Indian tribes as shown by a microscopical study of their head hair. State Museum, Denver.

SKULL OF A MIDGET FROM PERU

ALEŠ HRDLIČKA

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ONE PLATE

A brief report by J. Robert Wells, of La Oroya, Peru, on a remarkably small but otherwise apparently normal skull from Peru was published in a recent number of this journal ('42).[1] Since then the specimen has kindly been donated by Mr. Wells to the U. S. National Museum, has reached us in good order, and has proven one of the most remarkable objects of its kind not only in our collections but in existence. It now bears the U. S. National Museum no. 379510. In this brief report will be given a few additional notes on the specimen and its measurements. Mr. Wells may be complimented on the striking accuracy of both the observations and measurements that he has made.

The skull is in all probability that of a female, of about 16–17 years of age. The basilar suture is still partly open, and the third molars are completely within their sockets, though both showing partly on the labial sides of the maxilla. The lower jaw and all other parts of the skeleton are regrettably missing.

Except for its size, the skull is unquestionably a "normal" specimen, i.e. it shows nothing of any pathological nature. There also is no artificial deformation, though the occiput is somewhat asymmetrical and may have been affected slightly by an unintentional (from the right) cradleboard pressure; but the vault shows in the obelion region a fairly well marked external impression, approximately 2.8 cm. in diameter, looking as if it might have been produced by the pressure of some

[1] Mr. Well's report was originally in the form of a letter to Doctor Hrdlička, who made the necessary changes for publication — Editor.

round object. The internal wall shows no corresponding elevation.

Feature by feature the skull is a miniature of a normal ordinary specimen from the region. The Chilca burial grounds from which it comes are located on the coast of central Peru, south of Lima. I have collected from these cemeteries, and found much the same cranial type, but nothing corresponding in size to the present specimen.

A noteworthy condition in the skull is its relatively large dental arch. The teeth were in perfect alignment, and of slightly above medium size (M_1 10.5 mm. $\times$ 12 mm.). Only the first and second molars of each side remain, and they all, though particularly the first, show already plain marks of attrition. They also have, particularly the M_1, some deposits of tartar.

There are no asymmetries or relative subdevelopments of any of the facial parts, with the exception of the upper alveolar process, which is very low; this feature however is seen frequently in coastal Peruvian skulls. On the other hand the mastoids are somewhat larger than might have been expected in such a small and feminine skull, though not real large — the neck musculature of the subject was evidently well developed.

The thickness of the bones of the vault, 3–4 mm. along the parietals above the temporoparietal suture, is close to that in an ordinary full-sized female Peruvian skull. The foramen magnum, 2.8 $\times$ 2.6 cm., is somewhat larger than what one would expect in a skull of such dimensions. The spinal cord evidently was fairly stout, which points to a relatively good development of the body.

The sutures of the vault are all patent, show normal serration, and there are no intercalated bones, with the exception of a fair-sized ossicle just above the pterion in the right coronal suture.

On the base, the petrous portions are nearly on a level with the surface of the basilar part; there is a small dehiscence in the floor of the auditory meatus; and there are but rudimentary styloids — all as in many ordinary Indian skulls.

The dimensions of the specimen, compared with the means of same determinations on six ordinary adult female Chilca skulls, are as follows:

Measurements.

MEASUREMENTS AND INDICES	MIDGET SKULL, CHILCA	MEANS OF 6 NORMAL ADULT ♀ SKULLS, CHILCA	PERCENTAL RELATION (NORMAL = 100)
Approximate age	16–17 y.	32 y.	
Vault:			
Diam. antero-posterior maxim.	13.0 cm.	16.9 cm.	*76.9*
Diam. lateral maxim.	10.6	13.4	*79.1*
Basion-bregma height	10.0	12.4	*80.6*
Cranial module	11.20	14.24	*78.7*
Cranial index	*81.54*	*78.94*	*103.3*
Mean height index	*84.75*	*82.04*	*103.3*
Capacity (Hrdlička)	490–'5 cc.	1239.0 cc.	*39.7*
Thickness of left parietal above T. P. suture	3–4 mm.	3–5 mm.	
Face:			
Alveol. pt.-nasion height	5.1 cm.	6.4 cm.	*79.7*
Diam. bizygomatic maxim.	10.3	12.3	*83.7*
Facial index, upper	*49.5*	*52.4*	*94.5*
Endobasion-nasion	8.2	9.1	*90.1*
Endobasion-subnasal point	8.3	8.1	*102.5*
Endobasion-prealveolar pt.	9.5	9.2	*103.3*
Facial angle	*60*	*68.5*	*87.6*
Alveolar angle	*32*	*48*	*66.7*
Orbits:			
Height (mean of r and l)	3.07	3.37	*91.2*
Breadth	3.25	3.55	*91.5*
Orbital index	*94.6*	*94.9*	*99.7*
Nose:			
Height	3.85	4.71	*81.7*
Breadth	1.95	2.38	*81.9*
Nasal index	*50.6*	*50.4*	*100.4*
Upper alveolar arch:			
External length	4.9	5.0	*98.0*
External breadth	5.3	6.1	*86.9*
Arch index	*92.5*	*82.7*	*111.9*
Foramen magnum:			
Mean diam.	2.7	3.0	*90.0*

The measurements show a number of points of interest. The external proportions of the "midget" skull, while decidedly below the average of ordinary skulls of the same sex from the same locality, are nevertheless much nearer to the latter than is the capacity. This can only mean that the essential great differences between the two lie in the size of the brain. There are also rather marked differences in the form of the vault — that of the midget being relatively the broader. The somewhat greater relative breadth and hence cranial index, however, fall within the scope of individual variations of the locality, and so have no significance.

The difference in the size of the brain is, it is seen, not due to any special thickness of the midget skull, though proportionately to its size it may be regarded as slightly thicker than the average normals.

Some interesting features show also in the face. The relation in facial height between the midget and the normals is about the same as with the dimensions of the vault, but the face of the midget skull is proportionately somewhat broader, which correlates with the greater breadth of the vault, but at the same time points to a good development of the muscles of mastication. The main difference is in the facial and especially the alveolar protrusion, which in the midget skull is decidedly higher (angles lower). The greater facial protrusion stands in direct relation to the subdevelopment of the vault, while that of the alveolar process is due mainly to the lowness of the subnasal portion, together with the rather long dental arch.

The orbits in the midget skull are relatively large, and their index is practically the same as in that of the normals; the nose in the midget is relatively slightly larger, but its index is again practically identical with that of the normals; but the alveolar arch is relatively both broader and especially longer than in the normals, giving an index that is much higher.

The midget skull differs from the normals therefore by the very much smaller size of the brain; more marked facial and especially alveolar prognathism; relatively large orbits

and especially a relatively large dental arch; to which may be added a relatively large (particularly in relation to the brain) foramen magnum.

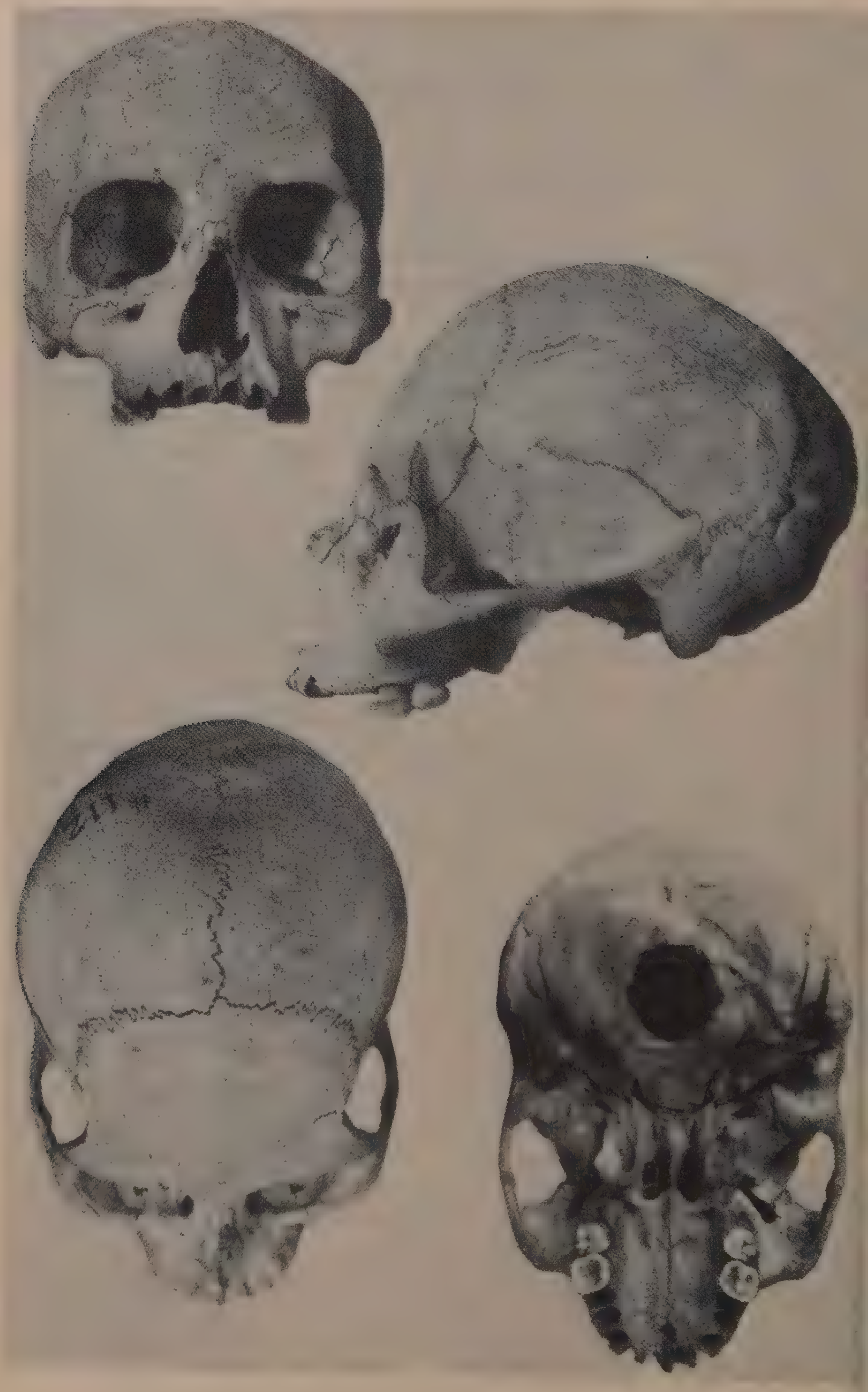
The vault has not been cut; but so far as it is possible to examine the cranial cavity, including the sella turcica, there is, aside of the size, nothing extraordinary.

The case naturally calls for some discussion. In many respects the specimen connects with those from Peru which I have reported on previously ('39). But there is a great gap between the size of even the smallest of these specimens (capacity 910 cc.) and that now at hand (490 cc.). It would seem that this little skull must have belonged to a midget, one of those diminutive beings who are just miniatures of the ordinary humankind, without presenting any detectable pathological condition. Just how such cases come about is as yet conjectural. They occur rarely among white people, too, but seemingly not in some human groups. They are not to be confounded with the more ordinary categories of dwarfs.

LITERATURE CITED

HRDLIČKA, ALEŠ 1939 Normal micro- and macrocephaly in America. Am. J. Phys. Anthrop., vol. 25, pp. 1–91.

WELLS, J. ROBERT 1942 A diminutive skull from Peru. Am. J. Phys. Anthrop., vol. 29, pp. 425–427.



Four views of the skull U. S. N. M. No. 379510 from Chilca, Peru.
(Original photographs natural size.)

OBSERVATIONS ON MEXICAN CRANIA [1]

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During a field trip to Mexico early in 1942 I was able to study the crania in two modern ossuaries, one at Guanajuato in the State of Guanajuato and the other at Saltillo in the State of Coahuila about 300 miles to the north.[2] The cranial data were sought primarily as a check against observations obtained on the living in the same neighborhoods, but they would seem to be of intrinsic interest per se since they probably represent conditions among the bulk of the present, or more precisely, the recent Mexican population in these regions.

It is common practice in Mexico, as in some other parts of the world, to disinter the remains of an individual about 5 years after burial, if the requisite rental fee for the ground is not paid by relatives of the deceased.[3] Often, and especially at the present time, the skeletal remains are burned shortly after disinterment. This whole procedure is deemed necessary, if I understand correctly, in order to provide space for new burials.

The crania studied at Guanajuato had been dug up between 1892 and 1910 from graves in the local necropolis. The bones and a number of remarkably well-preserved mummies are

[1] I am grateful to the Institute of Latin American Studies at the University of Texas for sponsoring the general Mexican field study of which this report is a part.

[2] It is a pleasure to acknowledge the generous letter of introduction given by Dr. Daniel Rubín de la Borbolla, head of the Department of Anthropology, Escuela Nacional de Ciencias Biologicas, which greatly facilitated work in the field, as well as the help of my assistant in the field, Srita. Concepcion Uribe, who recorded for me and was generally of inestimable assistance.

[3] Such is not the case, of course, where vault or burial ground has been bought outright and becomes private property.

preserved in an underground, well-kept ossuary in the cemetery where they form a bizarre exhibit and have become an attraction to visitors.

At Saltillo the disinterred bones, according to the caretaker, represented burials of between 10 and 20 years ago.

The people of Guanajuato and Saltillo are very generally of mixed White and Indian stock, with the Indian line usually prodominant and especially so among the lower economic groups. It will be recalled that disinterment of a burial implies poverty of the family concerned, and therefore it is virtually certain that most or all of the crania examined represent the local mestizo stock of predominantly Indian ancestry.

CRANIAL MEASUREMENTS

Measurements were taken, according to Hrdlička's Practical Anthropometry ('39), on 132 crania at Guanajuato and on 142 crania at Saltillo. Mean undeformed dimensions, indices, and variability are presented in table 1.

The mean dimensions and indices of the crania from each of these places are remarkably alike. No average diameter or index in the males differs significantly (4 x p.e.) between the two groups, and only cranial width, height, module, and nasal index reach 3 xp.e.[4] The crania of the females differ significantly, in a statistical sense, in cranial module (6.53 xp.e.), mean height index (6 xp.e.), and nasal index (5.39 xp.e.), all of these being an accentuation of differences noted in the males namely, a somewhat larger and higher vaulted skull at Guanajuato and a relatively narrower nasal aperture at Saltillo.

Both the Guanajuato and Saltillo series are mesocranic, the cranial index of the females being slightly larger than in the males. The vault is relatively high although in the Saltillo females absolute height tends to be low. The nose on the average is mesorhinic with the exception of the Saltillo males which are leptorhinic, but the actual indicial difference between the latter and the Guanajuato males in this character is

[4] The xp.e. was determined by inspection according to the tables given by Pearl ('40, pp. 505–511).

small and statistically insignificant. The nasal aperture is relatively broader in the females than in the males. Facial index suggests a relatively long face although it is bizygomatic narrowness rather than great length which gives the high index.

TABLE 1

Mean dimensions, indices and variability of crania from the states of Guanajuato and Coahuila in Mexico.

MEASUREMENT (MM.) OR INDEX	MALE					FEMALE			
	Place	No.	Mean	S.D.	Range	No.	Mean	S.D.	Range
Cranial length	Gto.	72	177.5	5.10	163 –190	54	170.8	5.74	160 –182
	Coah.	61	176.9	4.90	166 –186	76	168.1	6.68	155 –182
Cranial width	Gto.	72	137.6	5.26	128 –148	55	134.3	4.38	126 –148
	Coah.	60	135.6	5.07	126 –154	76	133.0	4.86	117 –142
Basion-bregma height	Gto.	71	135.0	5.01	121 –148	58	130.2	4.36	122 –138
	Coah.	59	132.6	5.62	122 –144	72	126.0	5.30	112 –138
Cranial module	Gto.	72	149.9	3.53	139.3–157.7	58	144.9	3.44	136.7–152.7
	Coah.	59	148.3	3.46	140.0–156.7	73	142.0	4.12	132.7–152.0
Bizygomatic width	Gto.	65	130.2	5.06	116 –142	50	123.6	4.88	112 –134
	Coah.	50	129.0	5.24	118 –144	55	121.9	5.56	106 –133
Nasion-prosthion	Gto.	53	70.2	4.88	58 – 83	36	66.5	3.70	60 – 74
	Coah.	40	71.4	4.32	62 – 79	46	66.0	3.37	58 – 72
Nasal height	Gto.	73	50.1	3.10	43 – 60	59	47.4	2.31	43 – 53
	Coah.	57	50.5	3.29	43 – 57.5	74	48.3	2.39	43 – 54
Nasal width	Gto.	70	25.0	1.62	20 – 28	59	24.3	1.94	21 – 29
	Coah.	56	24.2	1.89	20 – 28	71	23.5	1.80	20 – 28
Cranial index	Gto.	72	77.49	2.70	72.7– 84.7	53	78.83	3.76	71.4– 91.4
	Coah.	60	76.96	3.48	71.0– 84.7	75	79.00	3.48	72.2– 88.6
Mean height index	Gto.	71	85.76	2.91	80.5– 93.7	54	85.16	2.39	80.5– 91.4
	Coah.	56	84.68	3.19	78.1– 91.5	70	83.99	3.84	74.7– 93.9
Nasal index	Gto.	70	49.87	4.44	34.5– 58.7	59	51.25	4.22	41.5– 63.6
	Coah.	56	47.80	4.79	37.5– 57.1	71	48.65	3.86	40.0– 57.8
Upper face index	Gto.	49	53.85	3.80	44.6– 62.9	32	54.21	3.12	46.3– 60.5
	Coah.	37	54.94	3.17	48.4– 60.2	32	55.06	2.53	50.8– 60.2

The above discussion refers to average dimensions and indices. A survey of distribution in several characters indicates some interesting divergences between the Guanajuato and Saltillo series. Thus in table 2 it is noted that, although

TABLE 2

Distribution of cranial indices.

CLASSIFICATION	GUANAJUATO				COAHUILA			
	Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%
Delichocrany (70–74.9)	14	19.4	5	9.4	19	31.7	7	9.3
Mesocrany (75–79.9)	45	62.6	30	56.6	28	46.7	41	54.7
Brachycrany (80–84.9)	13	18.1	16	30.2	13	21.6	24	32.0
Hyperbrachycrany (85 and over)	..	....	2	3.8	..	....	3	4.0
Total	72	100.1	53	100.0	60	100.0	75	100.0

TABLE 3

Distribution of mean height index.

CLASSIFICATION	GUANAJUATO				COAHUILA			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
Low (x–80.4)	1	1.4	..	...	4	7.1	13	18.6
Moderate (80.5–83.4)	14	19.7	13	24.1	15	26.8	15	21.4
High (83.5–86.9)	32	45.1	32	59.3	24	42.9	29	41.4
Very high (87–x)	24	33.8	9	16.6	13	23.2	13	18.6
Total	71	100.0	54	100.0	56	100.0	70	100.0

mesocrany is predominant, the incidence of dolichocrany is also substantially greater in the Saltillo male series as compared with that of Guanajuato. The dispersion of mean height index [5] in table 3 shows the preponderance of high vault as

[5] According to Stewart ('40), modified slightly by splitting the high vault category into high and very high subdivisions.

implied by the averages, but one notes also an appreciably lower incidence of very high vault in the Saltillo series as compared with the Guanajuato group, as well as, in fact, a relatively high proportion of low vault in the Saltillo females.

Considering the tabular material as a whole, it seems to me that the similarities between the Guanajuato and Saltillo series of crania distinctly outweigh the noted differences and suggest close ethnic relationship. A discussion of the probable White and Indian components of the Mestizo population [6] must be left for another time although it is of interest to note

TABLE 4

Distribution of nasal index.

CLASSIFICATION	GUANAJUATO				COAHUILA			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
Leptorhinic (x–47.9)	21	30.0	14	23.7	28	50.0	32	45.1
Mesorhinic (48–52.9)	28	40.0	25	42.4	17	30.4	31	43.7
Platyrhinic (53–x)	21	30.0	20	33.9	11	19.6	8	11.2
Total	70	100.0	59	100.0	56	100.0	71	100.0

that, according to Kroeber ('39), Indian groups once inhabiting or more or less adjacent to the Guanajuato region were all mesocephalic: [7] Otomi (♂ 78.1, ♀ 79.2), Aztec (♂ 79.1, ♀ 79.6), Tarasco (♂ 77.1). As regards Saltillo and the present State of Coahuila, the brachycephalic Apache probably reached this region but at least one early group in Coahuila was also clearly dolichocranic (Studley, 1887; ♂ 74.4, ♀ 73.6) and it is of interest to note that to the west of Coahuila the Tarahumare Indians also tended to dolichocrany (♂ 75.9, ♀ 77.5). It will be recalled that of the crania adjudged males in the present series from Saltillo, 32% are dolichocranic.

[6] As far as I am aware there has been practically no Negro mixture in the regions of Mexico under discussion.

[7] The cited cephalic indices of the Otomi, Aztec, Tarasco, Tepehuane and Tarahumare are all from Hrdlička ('35). The term cephalic index refers to the living in contrast to cranial index of the skull (Stewart, '36).

VARIABILITY

Howells ('36) has elaborated a simple index which makes possible a summary of variability in a group. This "sigma ratio" is the standard deviation (sigma) of a character divided by "the average of a number of standard deviations for the same character taken from the literature and pertaining to adult male series of crania numbering forty or more" ('41, p. 144). The "mean sigmas" are given in table 5, as are

TABLE 5

Comparative sigma ratios.

MEASUREMENT OR INDEX	SALTILLO	GUANAJUATO	AMERICAN INDIAN	EARLY CHRISTIAN IRISH	MEAN SIGMAS
	%	%	%	%	mm.
Cranial length	80.5	83.7	88.9	99.3	6.09 (26)[1]
Cranial width	100.8	104.6	95.4	98.2	5.03 (26)
Basion-bregma height	109.8	97.9	91.4	98.8	5.12 (20)
Bizygomatic width	102.7	99.2	106.1	91.6	5.10 (22)
Nasion-prosthion	100.9	114.0	92.1	94.6	4.28 (23)
Nasal height	108.6	102.3	102.3	114.2	3.03 (16)
Nasal width	104.4	89.5	98.9	97.2	1.81 (25)
Cranial index	108.1	83.9	96.9	96.6	3.22 (23)
Nasal index	106.7	98.9	92.2	90.6	4.49 (15)
Upper face index	96.1	115.2	....	107.0	3.30 (8)
Mean sigma ratio	101.9	98.9	96.0	98.8	

[1] Figures in parentheses refer to number of separate series on which mean sigma is based (Howells, '41, pp. 146–147).

also the sigma ratios of several characters for series of Mexican, American Indian,[8] and early Christian Irish [9] crania (i.e., the standard deviation of each character expressed as a percentage of the corresponding mean sigma). According to Howells, a sigma ratio of 100 is the ideal of a "normal homogeneous" series; a ratio much less than 100 would suggest unusual homogeneity, a much higher ratio, unusual heterogeneity.

[8] From von Bonin and Morant ('38, p. 124) who give the average sigmas of a combined group of fourteen different groups of American Indians, calculated from data in the literature.

[9] From Howells ('41, pp. 146–147).

The sigma ratios of the Saltillo series are plainly somewhat greater than those of the Guanajuato group, possibly indicating therewith more White mixture or perhaps more diverse Indian components, in the former. It is of interest to note that the mean sigma ratios of the Mexican series are much the same as the corresponding ratios of the general American Indian series or early Christian Irish group, and further, that each closely approaches the ideal ratio of 100, indicative of a "normal homogeneous" series. This might seem paradoxical in that the Mexican series undoubtedly represent a mestizo or Indian-White mixture, and presumably should show greater variability than "pure" racial series like the fully Indian or early Irish. However, perusal of the literature on hybrid populations is rather enlightening on this point. Wagner ('32) and Howells ('36) each reviews the literature on variability in different groups, including mixed populations, and both authors point to instances of low variability in the latter. Indeed, according to Howells ('36, p. 595) "There is general agreement that hybrid groups do not necessarily exhibit an increased variability in their measurable characteristics over the parent groups involved. . . ." Wagner thought a "high degree of hybrid variation" would occur in those traits "which originally were divergent," a plausible contention (also made previously by Davenport and Steggerda who are cited in this connection by Wagner) which still remains to be fully checked. In any event variability is cited as either low or not unusually high in such divergent mixtures as European-Indonesian on the island of Kisar ("not more variable than typical European groups, i.e., Norwegians, or any other typical racial groups" — Howells, '36, p. 597), Maya-Spanish (Williams, '31), Hawaiian-Chinese and Hawaiian-European (Dunn, '28), "half-blood" Sioux (Sullivan, '20), American-Negroes (Herskovits, '30), and others. Dunn in his Study of Hawaiians of Pure and Mixed Blood, specifically states that "the hybrid groups cannot be distinguished from the 'pure' types merely by increased variability in single traits" and "So far as the measurements go, there

appear to be no absolute criteria of race or of stage of mixture'' ('28, p. 175).

Dr. H. L. Shapiro has explained the unusually low variability in English-Tahitian hybrids as resulting from ''long continued and extensive inbreeding among the islanders'' (cited by Howells, '36) and Williams also considers ''isolation, geographical or social'' (which in fact would compel inbreeding) as tending to ''create populations of low variability'' (p. 215). Already mentioned is the assumption of similarity of dimensions or characters in the parent stocks as a factor conducive to low variability. Whatever the reason or reasons for low variability, it may not be amiss to reiterate that degree of variability evidently is no positive criterion per se of ''purity'' of race. Even as regards homogeneity, Howells ('36, p. 592) admits that the sigma (and hence the sigma ratio which is based on absolute sigmas) merely ''gives a rough clue to the relative homogeneity of the series;'' only a clue, and a rough one at that. In other words, extreme caution obviously is necessary in the interpretation of variability as regards ''purity'' or degree of mixture of peoples.

A final word may be said with reference to the ordinary use of the term ''mixed-blood.'' Should a mixture of recent, old, or ancient duration in each instance be considered merely as ''mixed-bloods?'' Presumably one is a ''mixed-blood'' when somewhere along the line one of the parents was not of the same racial stock as the other parent. Hence, should one consider as ''mixed-blood'' the offspring of a Nordic father and an Alpine or Mediterranean mother? Each parent in the latter situation does represent a different racial group. Indeed, when is one a ''mixed-blood?'' And, as a matter of fact, is not use of the term ''blood'' in mixed-blood, half-blood, etc., quite inapropriate in a biological sense, as well as connoting erroneous and sometimes vicious implications to the layman as regards differences in blood between peoples? It seems to me that there is a definite need for definition and clarification of terms and concepts in studies of race mixture.

CRANIAL OBSERVATIONS

The following observations add somewhat to the description of these series, although, unfortunately, comparative data for their interpretation are lacking.

1. *Deformation.* Slight deformation, usually asymmetry or a depression in the lambdoid area, occurred in 25% of the Guanajuato crania and 13.3% of the Saltillo skulls. Deformation which might be considered moderate was noted in twelve skulls at Guanajuato (asymmetry, five; occipital flattening, three; lambdoid flattening, one, pre- and post-bregmatic depression, three) and in five crania at Saltillo (asymmetry, three; lambdoid flattening, one; flattening in region of parietal foramina, one). I doubt if deformation in any of these crania was intentional.

TABLE 6

Incidence of wormian and "Inca" bones.

ANOMALY	GUANAJUATO				COAHUILA			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
Wormian bones								
Present	20	27.4	18	30.5	13	20.6	26	32.5
Absent	53	72.6	41	69.5	50	79.4	54	67.5
"Inca" bone								
Present	1[1]	1.4	2	3.4	..	...	1	1.3
Absent	72	98.6	57	96.6	63	100	69	98.7

[1] Split in half, sagittally, by suture.

2. *Wormian and Inca bones.* Table 6 gives the incidence of wormian and Inca bones, respectively. Wormian bones occur fairly frequently in both the Guanajuato and Saltillo crania.

3. *Metopic suture.* A metopic suture occurred in 1.6% of the Saltillo males (one complete suture) and in 3.8% of the female crania (one complete, two incomplete sutures). At Guanajuato there was only one male skull with a metopic suture, complete, or 1.4% of the series.

4. *Pathology.* The atlas was completely synostosed to the foramen magnum in one male skull in both the Guanajuato and Saltillo series, respectively. In the latter group also

occurred one instance of a poorly healed broken nose, and another of apparent inflammatory lesions on the right and left nasal bones.

One skull at Guanajuato and one at Saltillo, in each instance a male, exhibited definite lesions of apparent syphilitic origin. One other skull from Saltillo, a female, seemed to have slight lesions of antemortem origin and possibly indicative of syphilis. In any event, it is remarkable that in each of these Mexican communities where syphilis was and still is prevalent, less than 1% of the crania should show any lesions which might be attributable to syphilis.

5. *General.* A pronounced bulge of the occiput, emphasized by a slight depression at about lambda, occurred over and again in the crania at both Guanajuato and Saltillo. At Saltillo the sex characters were usually very distinct: the presumably male skull manifesting much larger size, with medium to pronounced supraorbitals, and large mastoids. The nasal aperture in the crania from both cities often was asymmetrical; appreciable alveolar prognathism was not uncommon, prompting notation of the fact; the crania at Saltillo often manifested a high nasal bridge as well as a deep depression at nasion. Dental caries was common in the Saltillo crania, the teeth, anteriorly and in the molar region, often lost antemortem. Although not specifically noted in the Guanajuato series, my impression is that the dentition of the crania was generally much better than at Saltillo.

SUMMARY

Metric and visual observations were obtained on 132 crania from Guanajuato and 142 crania from Saltillo and in each instance representing the recent mestizo populations of these Mexican towns. Each series shows medium size of skull, mesocrany, relatively high vault, mesorhiny, and rather narrow face. In general the two series of crania are strikingly similar, suggesting close ethnic relationship. One male skull in each series exhibited distinct lesions, possibly of syphilitic origin.

LITERATURE CITED

BONIN, G. VON, AND G. M. MORANT 1938 Indian races in the U. S. A. Survey of previously published cranial measurements. Biometrika, vol. 30, p. 94.

DUNN, L. C. 1928 An anthropometric study of Hawaiians of pure and mixed blood. Papers, Peabody Mus. Am. Archeol. and Ethnol., Harvard Univ., vol. 9, no. 3.

HERSKOVITS, M. J. 1930 The Anthropometry of the Negro. N. Y.

HOWELLS, W. W. 1936 Some uses of the standard deviation in anthropometry. Human Biol., vol. 8, p. 592.

———— 1941 The early Christian Irish: The skeletons at Gallen Priory. Proc. Royal Irish Acad., vol. 46, sec. C, no. 3, p. 103.

HRDLIČKA, A. 1935 The Pueblos. Am. J. Phys. Anthrop., vol. 20, p. 235.

———— 1939 Practical Anthropometry. Phila., Pa.

KROEBER, A. L. 1939 Cultural and natural areas of native North America. Univ. Calif. Publ. Am. Archaeol. and Ethnol., vol. 38.

PEARL, R. 1940 Medical Biometry and Statistics. Phila., Pa.

STEWART, T. D. 1936 The cephalic (length-breadth) index. Am. J. Phys. Anthrop., vol. 22, p. 97.

———— 1940 Some historical implications of physical anthropology in North America (in Essays in Historical Anthropology of N. A.). Smithsonian Misc. Coll., vol. 100.

STUDLEY, C. A. 1887 Notes upon human remains from caves in Coahuila, Mexico. Rept. Peabody Mus. Am. Archeol. and Ethnol., Harvard Univ., vol. 3, p. 233.

SULLIVAN, L. R. 1920 Anthropometry of the Siouan tribes. Anthrop. Papers Am. Mus. Nat. History, vol. 23, pt. 3, p. 81.

WAGNER, K. 1932 The variability of hybrid populations. Am. J. Phys. Anthrop., vol. 16, p. 283.

WILLIAMS, G. D. 1931 Maya-Spanish crosses in Yucatan. Papers Peabody Mus. Am. Archeol. and Ethnol. Harvard Univ., vol. 13, no. 1.

THE "MASCULINE" COMPONENT AND PHYSICAL FITNESS

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ONE TEXT FIGURE AND FOUR PLATES

Since the development of the "Step Test," a simple method of measuring general physical fitness for hard muscular work (Brouha, Graybiel and Heath, '43), a considerable amount of data is now available on the variations in physical fitness of large groups of young college men before and after training. So extensive is this variation from individual to individual that it becomes pertinent to inquire as to the possible factors which exert influence in controlling and limiting the degree of physical fitness of healthy young men. It has been long recognized that one element in this problem is the question of physique or body build. Previous investigators such as Sheldon ('40) and Cureton ('41) have published studies dealing with the body build factor in physical fitness and athletic ability, but their work has been hampered in part by the lack of satisfactory physiological criteria. With the introduction of the "Step Test," however, there is now at our disposal a convenient, clear-cut, and objective measure of the physiological variable.

The purpose of this paper is to present data relative to the influence on physical fitness of one element in body build, namely the "masculine" component. The "masculine" component refers to the degree of maleness in the morphology of the individual. The male body build varies from the strong, rugged, well-muscled, angular, masculine type toward the

softer, rounder, less-muscled, feminine-like characteristics. The anatomical traits which make up this masculine or secondary sexual pattern are numerous and form a composite picture of the degree of masculinity of the individual. The more the composite pattern of anatomical traits tends in the direction of the extreme masculine type the stronger is the "masculine" component in the individual; the greater the departure from the masculine pattern towards the more feminine-like traits the weaker is the "masculine" component in the individual. The anatomical traits in question are readily discernable and have been described in considerable detail by Sheldon ('40) and Draper ('41).[1]

The contents of this paper will deal with the degree of masculinity of a large series of young college men in varying states of physical fitness just prior to training and after a period of physical conditioning.

THE MATERIAL

The study of the relationship of the degree of masculinity to physical fitness in untrained college students is based on data obtained on 1173 students of the Freshman Class of Harvard University who enrolled in June and September of 1942. The average age of this group was approximately 18 years. Immediately after enrollment, measurements of the physical condition of these students were obtained by means of the "Step Test." Coincident with this test of physical fitness, anthropometric measurements of body build were taken on the same individuals and an observation was made as to the degree of masculinity of the subjects. The freshmen who entered in June were again tested for physical fitness in September after approximately 12 weeks of physical training under the supervision of the Department of Physical Education. This took the form of regular conditioning classes,

[1] What is here referred to as the "masculine" component is usually designated as the "female" component in the males, or the mosaic of androgyny. The shift from "female" component to "masculine" component has been made for a number of practical reasons particularly concerned with its application in selection problems. See "Selection of Officer Candidates," by Woods, W. L.; Brouha, L.; Seltzer, C. C. Harvard University Press, 1943.

organized sports, and other forms of exercise of no less than 4 hours per week. In most instances the exercise period exceeded the 4-hour a week minimum. The freshmen who entered in September were again tested for physical fitness in December after undergoing a compulsory program of conditioning.

THE METHODS

The rating of the degree of masculinity or "masculine" component of each individual was made after carefully observing the subject in the nude. With the aid of standardized charts (plates 1–4) each individual was simply characterized as having either a strong, medium, weak, or very weak "masculine" component. A large number of anatomical traits were used to form the basis of the judgment of the strength or weakness of the "masculine" component.

Although the gradations from the strong "masculine" component to the very weak "masculine" component form a continuum, there is nevertheless no difficulty for a trained observer in assigning each subject to one of the four "masculine" component groupings. The main criteria used in rating the individual for his "masculine" component are given below:

Strong "masculine" component (plate 1).

1. General angularity and ruggedness of the body outline.
2. Sharply outlined musculature.
3. Interspace between thighs when heels together.
4. Freely dependent arms with no carrying angle or hyperextensibility of forearms.
5. Greater inner than outer curvature of calf muscles.
6. Narrower hip breadth relative to shoulder breadth.
7. Absence of feminine abdominal protuberance.
8. Constricted distribution of pubic hair running upwards towards navel.
9. Flatness in mammary area.
10. Good muscle tonus.

Medium "masculine" component (plate 2).

1. General roundness and softness of the body outline.
2. Absence of sharply defined musculature.
3. Approximation of thighs when heels together.

4. Obtuse carrying angle and beginnings of hyperextensibility of forearms.
5. Beginnings of greater outer curvature of calf muscles.
6. Greater hip breadth relative to shoulder breadth.
7. Beginnings of feminine abdominal protuberance.
8. More lateral distribution of pubic hair along inguinal folds.
9. Beginnings of fullness in mammary area.
10. Beginnings of weakness in muscle tonus.

Weak "masculine" component (plate 3).

1. Pronounced roundness and softness of the body outline.
2. Absence of sharply defined musculature.
3. More extensive approximation of thighs when heels together.
4. Greater obtuse carrying angle and hyperextensibility of forearms.
5. Greater outer curvature of calf muscles.
6. Markedly greater hip breadth relative to shoulder breadth.
7. Feminine abdominal protuberance with suggestion of abdominal folds.
8. Lateral distribution of pubic hair along inguinal folds.
9. Fullness in mammary area.
10. Poor muscle tonus.

Very weak "masculine" component (plate 4).

More pronounced development of the characteristics of the weak "masculine" component.

It should be noted that the possession of every single one of the traits above is not an absolute requisite for assignment to any special category. What is necessary is the overall approximation of the individual to the pattern of any specific gradation.

The physical fitness of the individual was judged by the score obtained in the "Step Test." Briefly, this test gives the subject a standard amount of muscular work which brings him to the point of near exhaustion and measures the recovery rate of his pulse after the cessation of the exercise. Actually the subject steps up and down a 20-inch platform at the rate of thirty times a minute for a 5-minute period or as long a period up to 5 minutes as he can maintain the required pace. After

the end of the exercise, 30-second pulse counts are taken after 1, 2 and 3 minutes of recovery. The sum of these three pulse counts is multiplied by two and the result is divided into the number of seconds in the period of the exercise. The final figure obtained is called the physical fitness index. The score is on an absolute scale and is interpreted on the basis of a large number of experiments as follows: a score below 55 is considered poor; 55–64 is low average, and 65–79 is average in physical fitness; 80–89 is good, and 90+ is superior in physical fitness.

ANALYSIS OF THE DATA

"Masculine" component and physical fitness in students before training. The physical fitness scores of 1173 freshmen of the Harvard Class of 1946 ranged from 15 to 115. The average physical fitness score for the class as a whole was 69. A score of 65 is considered to be the lower limit of the group which is average in physical fitness. If we divide our series

TABLE 1

"Masculine" component and physical fitness before training.

"MASCULINE" COMPONENT	PHYSICAL FITNESS Scores under 65		Scores 65 and over		Total	
	No.	%	No.	%	No.	%
Strong	128	49	812	89	940	80
Medium	77	30	89	10	166	14
Weak and very weak	55	21	12	1	67	6
	260	100	913	100	1173	100

into two groups, those with physical fitness scores below 65 and those with scores above 65, we have a dichotomy which roughly separates the individuals with poor physical fitness from those whose physical condition is average or good. Table 1 gives the "masculine" component ratings for those individuals with physical fitness scores below 65 in contrast to those above 65. From the figures in this table it is clear that the degree of masculinity in untrained individuals is associated with the extent of their physical fitness. Those individuals in

poor physical condition (with scores below 65) show a much greater frequency of the weaker "masculine" types of physiques than those persons who are average or good in physical fitness (with scores over 65). Thus, the strong "masculine" component was observed in 89% of the group with physical fitness scores of 65 and over and in only 49% of the group with scores below 65. Medium "masculine" components were found in only 10% of the individuals with fitness scores of 65 and higher, compared with 30% in the low physical fitness category. Weak or very weak "masculine" components were observed in but 12 out of 913 individuals or roughly 1% of the higher physical fitness group, while this type of physique occurred in 21% of the lower physical fitness category.

TABLE 2

"Masculine" component and physical fitness before training.

PHYSICAL FITNESS SCORES	"MASCULINE" COMPONENT Strong		Medium		Weak and very weak		Total	
	No.	%	No.	%	No.	%	No.	%
65 and over	812	86	89	54	12	18	913	78
Below 65	128	14	77	46	55	82	260	22
	940	100	166	100	67	100	1173	100

If these figures are recalculated using the "masculine" component as a base of reference (table 2) it appears that 86% of the individuals with strong "masculine" component have physical fitness scores of 65 and higher and only 14% have scores below 65. Individuals with medium "masculine" component are almost equally divided into the higher and lower physical fitness dichotomy. But of the individuals with weak and very weak "masculine" component only 18% attained a score of 65 and greater while the remaining 82% showed physical fitness scores below 65.

These results indicate that the "masculine" component is associated with the degree of physical fitness of untrained individuals. Any weakness in "masculine" component seems to go along with lower physical fitness. The weaker the

"masculine" component the greater the frequency of poor physical fitness.

"Masculine" component and physical fitness in students after training. As part of the physical training program of Harvard University all students were required to participate in some sort of conditioning exercises under the supervision of the department of physical education. For the most part, this took the form of regular conditioning classes, although Army and Navy R.O.T.C. training programs and organized athletics were often substituted. In any event, the minimum requirement was 4 hours per week of conditioning. The data contained here relative to the "masculine" component and physical fitness after training give the results obtained on 725 students after approximately 12 weeks of conditioning.

TABLE 3

"Masculine" component and physical fitness after training.

PHYSICAL FITNESS SCORES	"MASCULINE" COMPONENT Strong		Medium		Weak and very weak		Total	
	No.	%	No.	%	No.	%	No.	%
Below 55 (poor)	5	12	9	22	26	65	40	99
55–79 (low ave. and ave.)	283	65	103	24	47	11	433	100
80–89 (good)	161	92	11	6	4	2	176	100
90+ (superior)	76	100	0	0	0	0	76	100
	525		123		77		725	

The series consists of a group of 367 June Freshmen of the class of 1946 who were re-checked by the "Step Test" in September, a group of 135 September Freshmen of the class of 1946 who were re-checked in December, and the remainder includes several small groups from the cross-country team, crew, basketball, R.O.T.C. seniors and enlisted reserve corps students. The inclusion of the small series of athletic team members was made in order to give a greater representation of the higher physical fitness categories.

Table 3 gives the data on the relationship between the "masculine" component and physical fitness after a minimum

of 12 weeks training.[2] Of the individuals with poor physical fitness (scores below 55) only 12% were characterized as having a strong "masculine" component, 22% were designated as medium in "masculine" component, and the remaining 65% were weak or very weak in the "masculine" component. The group of students with low average and average physical fitness (scores 55–79) consisted of 65% of individuals with a strong "masculine" component, 24% of medium, and only 11% of the weak or very weak category. Of the subjects with good physical fitness (scores 80–89) 92% were strong in "masculine" component, and the remaining 8% were medium, weak or very weak. All the individuals of superior physical fitness (scores 90+) were of the strong "masculine" component variety.

From these figures it is apparent that there is a relationship between the degree of masculinity of individuals and their physical fitness even after training. The higher the physical fitness the less frequent the weaker masculine body build types. Conversely the more frequent the appearance of the weaker masculine body builds the lower the physical fitness. The highest physical fitness seems to be attainable only by those individuals who are strong in "masculine" component. It should be noted that even a slight weakness in the "masculine" component is a limiting factor in the degree of physical fitness of individuals. It is not necessary to have much evidence of weakness in the "masculine" component before its influence on the physical fitness of individuals is readily apparent. To illustrate this point figure 1 is given contrasting the strong "masculine" component group with the combined medium, weak, and very weak types for the several gradations of physical fitness.

[2] The average improvement in physical fitness amounted to approximately 7 units. For example, the average score for June freshmen before training was 69 and after training 76. The group of September freshmen presented an average score of 64 before training and 71 after 12 weeks of physical conditioning.

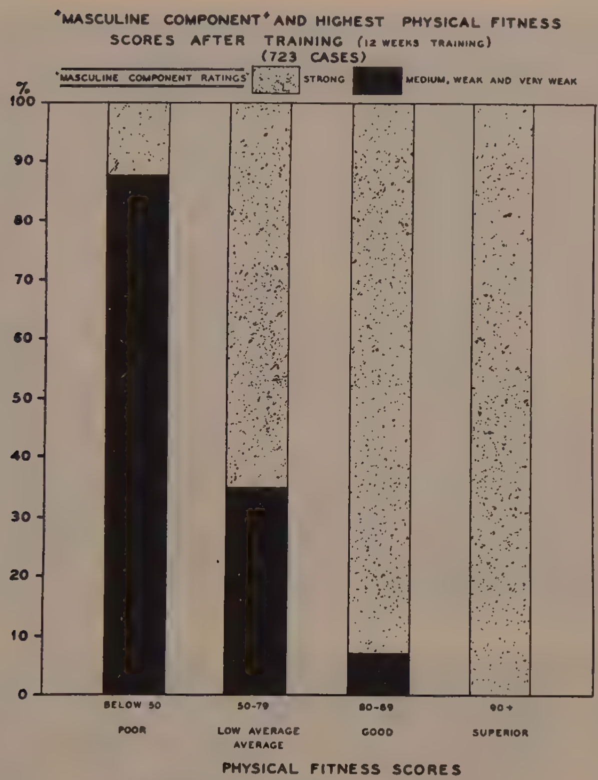


Figure 1

SUMMARY AND CONCLUSIONS

1. The "masculine" component in young men can be arbitrarily divided into four categories: strong, medium, weak, very weak.

2. The degree of "masculine" component is related to physical fitness for hard muscular work both before and after training.

3. The higher the physical fitness, the less frequent the body types weak in masculinity.

4. A superior degree of physical fitness can be achieved only by the subjects who have a strong "masculine" component.

5. Any weakness in the "masculine" component seems to go along with lower physical fitness.

6. The weaker the "masculine" component, the greater the frequency of poor physical fitness.

LITERATURE CITED

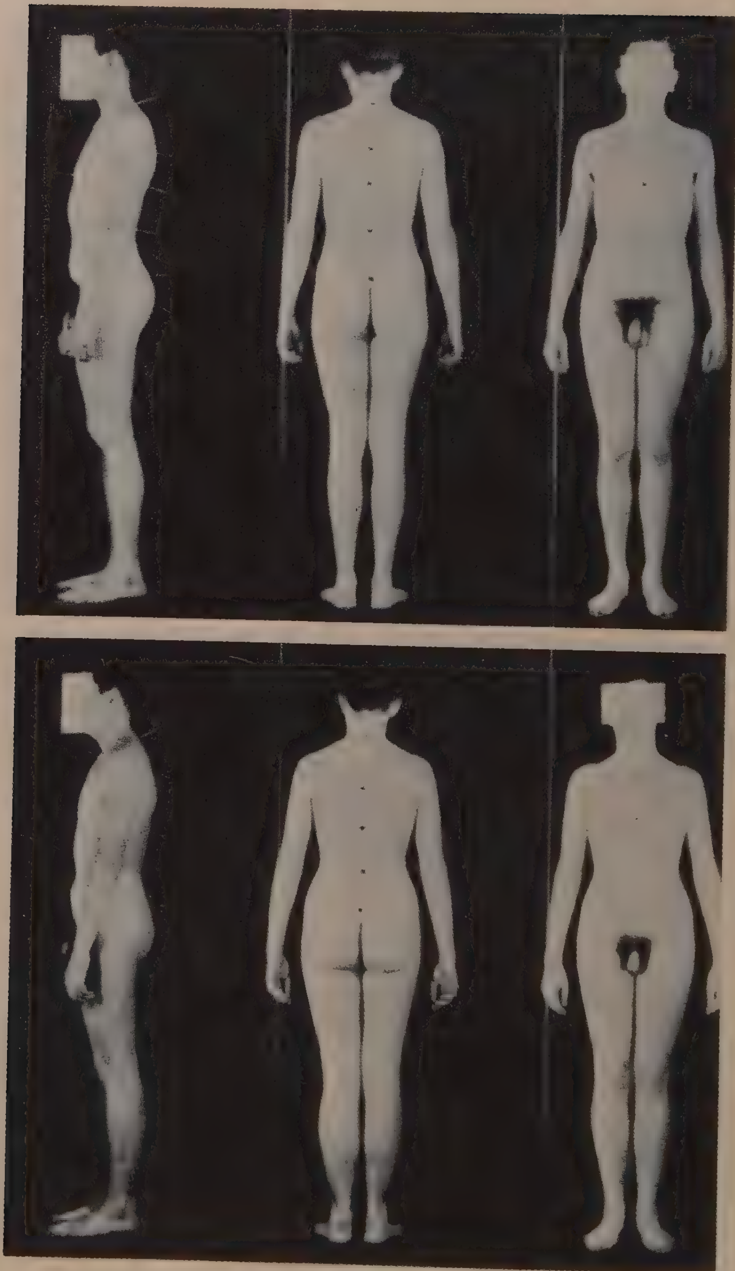
BROUHA, L., A. GRAYBIEL AND C. W. HEATH 1943 The step test. A simple method of measuring physical fitness for hard muscular work in adult men. Rev. Can. Biol. (In press.)

CURETON, T. K., JR. 1941 Body build as a framework of reference for interpreting physical fitness and athletic performance. Suppl. Res. Quart. Am. Assoc. Health, Phys. Ed. and Rec., vol. 12, no. 2, p. 301.

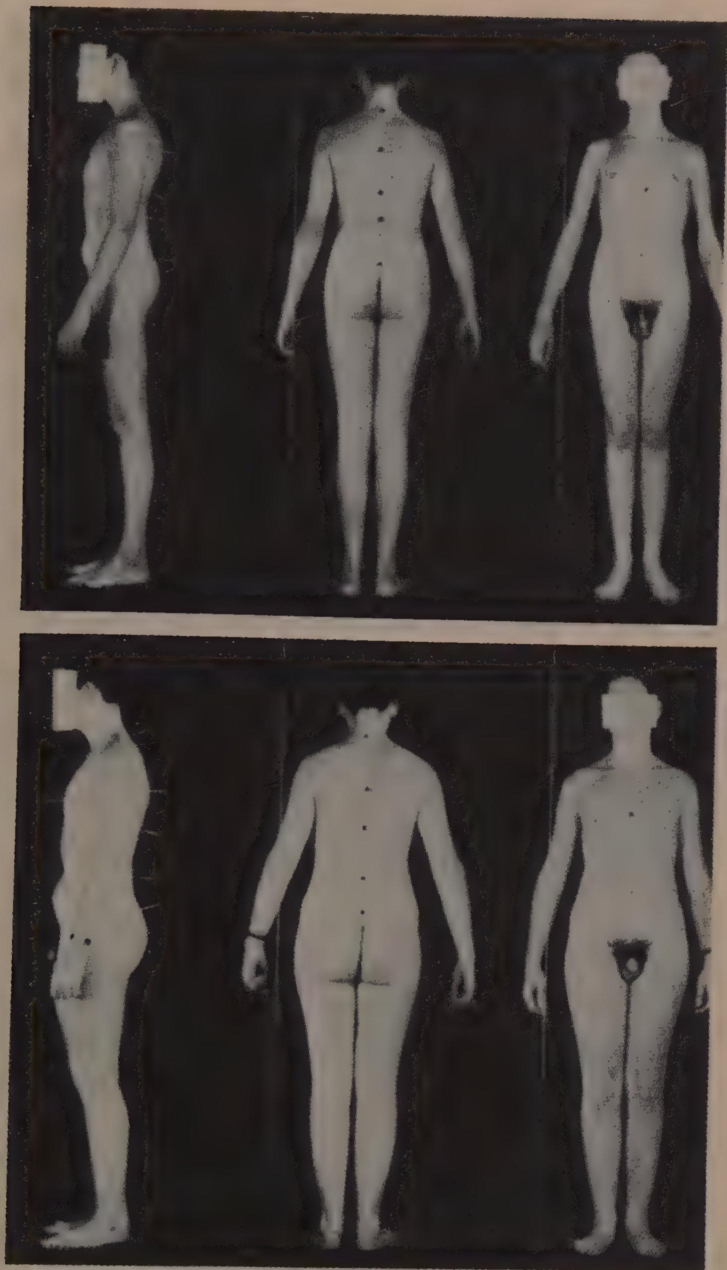
DRAPER, G. 1941 The mosaic of androgyny. New England J. Med., vol. 225, no. 11, p. 393.

SHELDON, W. H. 1940 The Varieties of Human Physique. Harper and Brothers, New York.

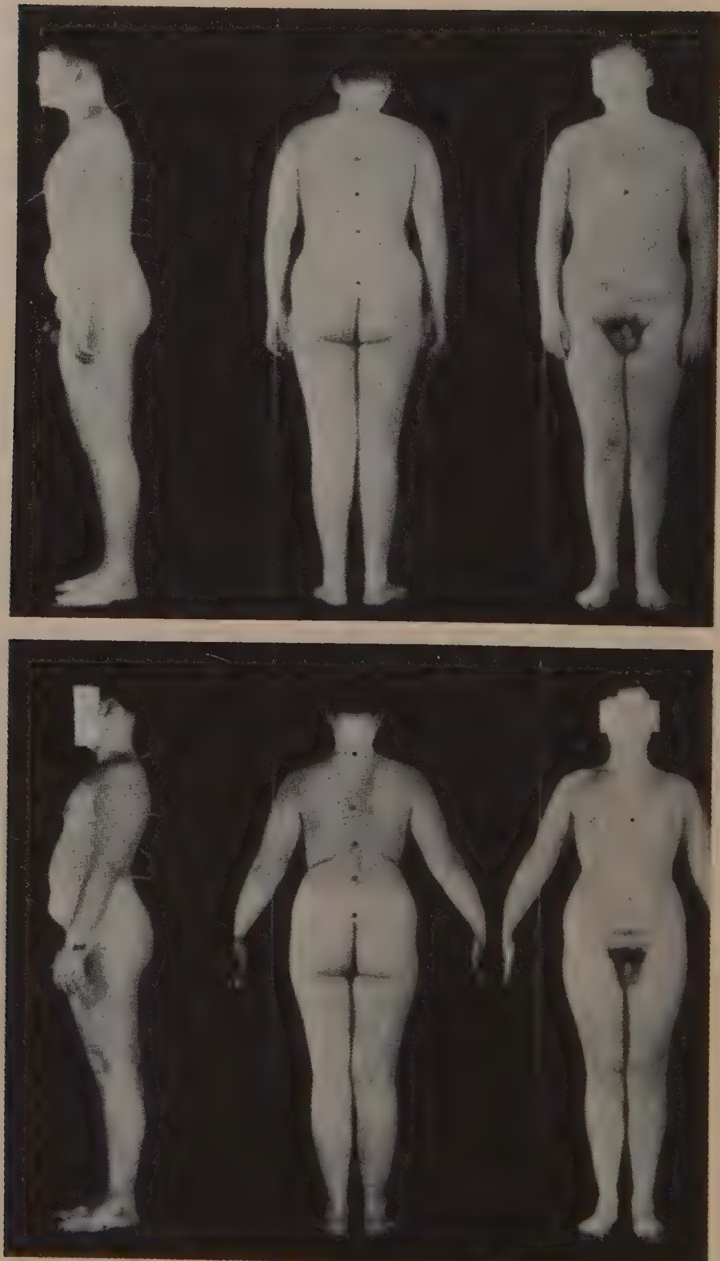
Strong "masculine" component.



Medium "masculine" component.



Weak ''masculine'' component.



Very weak "masculine" component.

REVIEWS

NEGROES IN BRAZIL, A Study of Race Contact at Bahia. By DONALD PIERSON, University of Chicago Press, Chicago, Ill., xxviii + 392 pp., 1942. ($4.50.)

Brazil is a military ally of the United States, her Negro population is nearly as large, and her policy toward that population has been the reverse of this country's, hence a sociological work of this nature will be of compelling interest to all who realize what is involved in the concept of "hemisphere solidarity." To the physical anthropologist the background thus provided for work in his field is invaluable.

The racial situation in Brazil is complex and confusing in many aspects. In this book the American professor of sociology in the Escola Livre de Sociologia e Politica de São Paulo has made a clear, scholarly and authentic exposition of the matter. The study carries the endorsement of inclusion in the University of Chicago Sociological Series and there is an introduction by Dr. Robert E. Park.

The principal data were gathered during 22 months' residence (1935–1937) in the old seaport of Bahia, a locality where "the processes of racial adjustment have perhaps gone on longest and most persistently, have involved large numbers from each of the three basic human races, and the ensuing termination is perhaps most clearly discernible." The stable character of the population of this community and its cultural passiveness made it more representative of established trends in Brazil than areas markedly subject to modern foreign influence.

Class, not race, it was found, is in a general way the basis of social status in Brazil, and the upper reaches are open to any who manage to attain the measure of heritage, wealth, position or occupational eminence considered to qualify one for them. Yet the racial distribution in the classes at Bahia was very uneven, with great preponderance of whites at the top, mixed bloods in marginal position and blacks at the bottom. Both of these phenomena have a historical basis.

Three factors appear to account for the lack of color allergy in the Brazilian. The Portuguese who first settled Brazil were accustomed

to dark people in high places in their homeland, as a result of legacies from the Moorish occupancy and other African infusions. In the early days of Brazil, Portugal was being drained of her manpower by colonizing ventures in other parts of the world so that to obtain a population sufficiently European to secure the country, unions first with native Indians and later with imported Africans came to be encouraged in one way or another. Finally, as a vast independent country without the highly developed and convenient transportation systems so important in the knitting together of the United States, and colonized by immigrants of many nationalities in widely separate closed communities, Brazil has been intent upon absorbing and assimilating all its population elements lest the country eventually disintegrate. In this respect the Negro has presented no problem.

The racial distribution in the classes is essentially a matter of circumstantial advantage, the whites having started with title to all rights and possessions and the blacks with neither civil rights nor property, the mixed bloods being endowed originally according to the status of their progenitors.

The author gives a concise account of the conditions of slavery in Brazil, the insurrections, abolition sentiment and the progress of admixture and the admixed. He presents extensively his first-hand information on racial attitudes as manifest in a great variety of mores and on African survivals and acculturation.

Although Brazil's policy of assimilation has presented no obstacle to the Negro, and an unparalleled amount of amalgamation has occurred there, the circumstantial coincidence of color and class has resulted in the continued existence of many unabsorbed blacks. The social isolation of the latter has to some degree fostered among them the survival of more or less modified Africanisms, which have in themselves acted to retard acculturation.

Miscegenation as a biological matter appears to meet with Brazilian approval. It is widely regarded as inevitable and advantageous, but dissenting expressions are cited by the author, who furnishes considerable collateral information on the subject. The Bahians term "moreno" the new physical type which is developing in Brazil, corresponding to the "brown American" of the United States, and a "morena" (feminine moreno) is stated to be the "ideal type" of femininity in Bahia.

Recent manifestations of national interest in the Negro and of specific race consciousness in other Brazilian localities, chiefly southern cities like Rio de Janeiro and São Paulo which have received much foreign immigration in the last century, are described.

While the author considers that, "the racial situation at Bahia probably is, in a general way, typical of all Brazil," he recognizes

that in industrialized areas some modification of the preexistent attitudes in the direction of prejudice has occurred. This is a matter of great importance because of the closer post-war international relationships which may be anticipated. American influence in Brazil is on the rise. Its possible effects on future race attitudes are not discussed, but the author does point out fundamental differences in the background of the American majority attitudes which focus about the facts that in the English settlement of the United States, European women emigrated in large numbers, and, that Brazil never had either a Civil War or its prodromata or after effects.

Reader interest is heightened by incidentals throughout the book such as the note on sixteenth century germ warfare in the custom of planting clothing infected with the virus of smallpox in Indian villages to decimate the inhabitants. A photograph of a beautiful typical Negro girl of Bahia makes a decorative frontispiece, and appendixes, a selected bibliography and a good index are useful closing items. All constructively interested in the world of tomorrow may digest this book with profit.

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THE "AUSTRALOID" IN CALIFORNIA. By Earl W. Count. Zeitschr. f. Rassenk., vol. 8, 1938, pp. 62–95.

PRIMITIVE AMERINDS AND THE AUSTRALO-MELANESIANS. By Earl W. Count. Rev. Inst. Antrop., Tucumán, vol. 1, 1939, pp. 91–159.

THE AUSTRALOID PROBLEM AND THE PEOPLING OF AMERICA. SECOND CONTRIBUTION: A CONSIDERATION OF THE THREE CARDINAL CRANIAL DIMENSIONS. By Earl W. Count. Rev. Inst. Antrop., Tucumán, vol. 2, 1941, pp. 121–176.

Although these three monographs have been published so widely apart, they deal essentially with the same subject and the same material. They are concerned with a study of certain craniometric characters of three Californian skulls, nos. 2503, 316, and 4561 supposedly suggestive of an Australo-Melanesian element in North America. It is the author's belief that these three crania have the

"same essential morphological characters" as certain groups of Australian, Melanesian, Oceanic and South American cranial series.

The first monograph is almost wholly confined to an analysis based on skulls nos. 2503 and 316. After presenting the measurements and indices of these two Californian crania, Doctor Count compares the deviation of their indices (only) with the means and ranges of the corresponding indices in the following series: Mollison's thirteen unsexed Australians, Gusinde and Lebzelter's forty-four unsexed Australians, forty unsexed Fuegians, less than thirty male Yamana, eleven unsexed Selknam, six unsexed Halakwulup, Mollison's seventeen unsexed Maori, etc.

In the second monograph, the three Californian skulls are compared with Hooton's, "Pseudo-Australoids"; Hrdlička's, "North Australians"; Von Luschan's, "New Britons"; Bauer's, "New Pomeranians" in addition to about a dozen individual Oceanic crania (primarily from New Britain). These comparisons are based on eight indices, no measurements being included.

The third monograph contains a discussion of the literature dealing with the Australoid problem in America, which is followed by a very complicated analysis of the "three cardinal cranial dimensions" (length, breadth, and height) of several series of Australian, Oceanic and North and South American series. This latter section deals with multiple intercorrelations of these three cranial dimensions for the purpose of estimating their taxonomic values in ethnic comparisons.

The general procedure employed in all these studies was to measure the deviation of the indices of the three Californian crania from the means and ranges of the corresponding indices of the numerous groups of Australian, Oceanic and American series. If the indices of the Californian skulls fell close in terms of standard deviation distances to the corresponding means of the Australian and other series, this was interpreted by Doctor Count as indicating relationship between them. Also, when the indices of the three Californian skulls fell within the ranges of the respective indices of the various series (or if only occasional indices fell outside the range) this also indicated essential relationship. As a result of such analysis Doctor Count arrived at the general conclusion that these three Californian crania have definite Australian, Melanesian affinities and in certain instances indicated they could pass for genuine Australian and other Oceanic forms.

Below are a few quotations from Count's monographs which illustrate the nature of the conclusions arrived at:

"While the data have not been all that could be wished for, and the analysis is still incomplete, on several counts it is clear that skulls with the same essential

morphological characteristics are present in Australia, Melanesian Oceania, southern South America, California.

Two strains are distinguishable in California; the one leaning more to the Australian, the other to the Melanesian; at the same time, the claim for essential relationship between the two Austral groups seems by our analysis to be incidentally strengthened.

At the same time, most distinctly the specimens analyzed here are not ''Amerindian,'' if by that is meant some kind of Mongoloid, or if by that is meant a racial homogeneity in the western hemisphere or the North American continent or even the United States.'' (p. 95, first monograph.)

''Californian n. 2503 places best with the Australian, but atypically; Californian n. 316 places excellently with both New Pomerian and New Britons, and in that order; Californian n. 4561 places excellently with all four norms and in this order: New Pomeranians — Pseudo Australoids — New Britons — Australians.'' (p. 151 of second monograph).

''Thus our estimate in the previous paper stands: *in so far as the indices show the specimen (2503) could pass for a genuine, but not statistically typical, Australian.*'' (p. 117, second monograph.)

''Now, the analysis, it seems to me, says definitely that we are dealing with a population morphologically on a level with the Oceanians discussed. Also, that no. 2503 and no. 316 represent divergent morphologies on this level. I believe that, as far as a mere eight indices can show, this points a fact.

But does this identity of morphologic level mean genetic relationship of a relatively recent nature with Oceanians, or does it mean separate survival from a very distant past? Is it parallelism or blood-tie?

I cannot dogmatise. There is no definitive evidence. But it seems to me that, the greater the number of coincidences in indices between two subjects, the less the chance that the connection is merely accidental, or even that it is *very remote* — whatever that phrase may mean.'' (p. 156, second monograph.)

''As for my concrete taxonomic results there is no pretense that they are extensive or important. They need other cranial data to support or direct them. But they certainly do not conflict — rather, by and large they harmonize — with the claim that Australo-Melanesian types are present in America, both North and South.'' (p. 173, third monograph.)

Since it is not possible within the confines of this short review to enter into a detailed discussion of the problem of the ''Australoid'' element in the American Indian, this reviewer will restrict his comments to the validity of the evidence contained in these articles.

It would appear that the crucial issue in these monographs centers around the validity of the general methodology used by Doctor Count in arriving at his sweeping conclusions. Is Doctor Count proceeding on a logical and sound basis in reaching the conclusion that there is an Australo-Melanesian element in the American Indian considering the extent of his material and his methods of analysis, wherein he

compares certain indices of three Californian skulls with the mean indicial values of various Australian and other Oceanic forms? It is this reviewer's opinion that the answer to this question is clearly, no.

There are a number of cogent reasons for arriving at this conclusion. However, the fundamental weakness in Doctor Count's method can best be exposed by means of a few simple illustrations whereby another dubious conclusion is reached using the same kind of data and the same method of analysis. In the table below, Anglo-Saxon skulls from Burwell and Bidford-on-Avon, England (Biometrika, vol. XXVII, 1935, pp. 373–408, appendices I and V) are submitted to the same analytical procedures utilized by Doctor Count in the case of his three Californian skulls. The Anglo-Saxon skulls are compared with Hrdlička's series of North Australians for the same eight craniometric indices. The figures given are the differences of the Anglo-Saxon indices from the mean indicial values of the North Australian series in terms of the standard deviations of the means of the Australians. Similar figures for Doctor Count's three California crania are also given for comparison.

TABLE

Differences between indices of Californian and Anglo-Saxon skulls from the corresponding mean indices of Hrdlička's North Australians.[1]

	CALIFORNIAN			ANGLO-SAXON		
				Burwell England		Bidford-On-Avon England
	No. 2503	No. 316	No. 4561	No. 16	No. 23	No. 107
Cranial index	—1.36	+2.5[2]	+2.07	—0.11	+1.71	+0.82
Height-length index	—1.29	+0.22	+1.18	—1.29	—1.16	—0.77
Height-breadth index	—0.06	—1.87	—0.73	—1.20	—2.49	—1.48
Total facial index	—0.41	+0.17	+0.11	+0.91	+0.26	+0.39
Upper facial index	—1.13	—0.82	—1.07	+0.34	—0.21	—0.21
Orbital index	—3.02[2]	—1.47	—0.93	—1.51	—0.55	—2.15
Nasal index	+0.60	—1.88	+0.58	—1.41	—1.19	—1.17
Gnathic index	—0.56	—0.42	—1.09	—1.97	—2.20	—1.72

[1] Following Doctor Count's procedure the differences are given in terms of the standard deviations of the means of the Australians (diff./σ).

[2] Indices beyond the range of the Australian series.

If we were to follow Doctor Count's deductive reasoning, then the figures above would indicate that the Anglo-Saxon skulls are "Australoid" in their affinities to the same extent as the California crania. As a matter of fact Anglo-Saxon skull no. 16 might even be considered more "Australoid" than any of Count's Californians. In no single instance do the indices of the Anglo-Saxon skulls fall

beyond the ranges of the corresponding Australian indices. In contrast, the orbital index of Californian no. 2503 is beyond the range of the Australian series, as is the cranial index of Californian no. 316. Anglo-Saxon skull no. 16 has no index greater than 1.97 standard deviation distances from the mean indicial values of the Australians. In contrast, California no. 2503 has an orbital index of 3.02 standard deviation distances, California no. 316 a cranial index of 2.5 standard deviation distances, and California no. 4561 a cranial index of 2.07 standard deviation distances.

Anglo-Saxons and Australians are both members of the division of mankind which is called White or Caucasoid. The fundamental community of human characteristics is present and in addition possibly some similarity in more restricted pecularities. But it would be a rash anthropologist who would base any assumption of "an Australoid strain" in Anglo-Saxons upon moderately close resemblance of two or three Anglo-Saxon skulls to the entire range of the respective indicial variations in a long series of Australians.

It is then wholly possible that a selection of two or three crania from one long series which most closely resemble the generality of a supposedly unrelated series may reveal that they do fall within the range of the latter. Such occasional resemblances may be fortuitous. They can hardly be accepted as evidence of close genetic relationship. To obtain such evidence comparisons between adequate samples should be instituted. We are forced to conclude that the deductions reached by Doctor Count considering the nature of the data he has presented, are invalid.

It should be emphasized to the reader that the critical review of Doctor Count's monographs in no way reflects the reviewer's opinion as to the question of the "Australoid" element in the American Indian. That is another matter. All that is maintained here is that the material presented by Doctor Count cannot be considered as positive indications.

This whole problem of the "Australoid" element in the American Indian is a very important one and should be more fully considered by workers concerned with the physical anthropology of the American Indian. Doctor Count should be commended for tackling such a ticklish and difficult subject. It would be very interesting to see what results might evolve from a study based on a larger number of specimens, with an analysis of a relatively complete set of measurements, indices, and observations.

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DIE FEUERLAND-INDIANER. III (PT. 2) ANTHROPOLOGIE. By MARTIN GUSINDE. Verlag "Anthropos," Wien-Mödling, 8 vo., xvi + 511 pp., 69 text figures and a folder containing illustrations and maps, 1939.

I am indebted to Dr. John M. Cooper of the Catholic University in Washington, one of the foremost students of the Fuegians, for the loan of this publication for review purposes. In view of the fact that this work was printed at a time when the war was interrupting communications, it is unlikely that there are many, if indeed any, other copies in this country. This circumstance and the importance of this work are judged to be sufficient reasons for an extensive review.

Like the preceding volumes in the series this one is considerably inflated by references to and quotations from the general literature. The basic material, thus somewhat obscured, consists of detailed measurements on 110 living Indians (24 male, 22 female Selk'nam or Ona; 14 male, 19 female Yamana or Yahgan; 15 male, 16 female Halakwulup or Alacaluf) and 106 skulls (26 male, 9 female Ona; 35 male, 20 female Yahgan; 8 male, 8 female Alacaluf). The measurements on the living are all original with Gusinde and no effort has been made to combine them with measurements taken by others in an effort to get larger series. The skull measurements, on the other hand, are for the most part not original with Gusinde, only 15 skulls (5 male, 4 female Ona; 3 male, 3 female Alacaluf) having been collected by him. Nevertheless, Gusinde (and Lebzelter, who died before the work was finished) should be given credit for assembling the largest cranial series of these tribes yet to be presented, including a number of specimens not heretofore described. It is important to note, too, that although measurements on many of these skulls already had been reported in the literature, those here listed are for the most part new. The reason for this is that more numerous and carefully standardized measurements were desired and hence they were remeasured completely (except often cranial capacity). Non-metrical observations are given only in summary form.

The amount of space devoted to the individual measurements is as follows: For each living male Ona there are 83 different measurements, and for each female 67; for the Yahgan 53 and 59, respectively; and for the Alacaluf 79 and 72, respectively. These measurements yield for each sex 46 indices in the case of the Ona, 55 for the Yahgan, and 44 for the Alacaluf. Altogether these tables

occupy 34 pages. In the case of each skull there are 139 different measurements and 47 indices. These occupy 42 pages.

Some of the average measurements for the living were published earlier and need not be repeated here. The cranial measurements, however, are new and for this reason some of the more useful means for the males are given below.

	ONA mm.	YAHGAN mm.	ALACALUF mm.
Cranial length	(26) 191.8	(39) 186.0	(12) 189.8
Cranial breadth	(26) 143.0	(39) 142.8	(12) 141.8
Cranial height	(26) 136.2	(38) 136.0	(12) 139.2
Cranial index	(26) *74.3*	(39) *76.6*	(12) *74.7*
Mean ht. index	(26) *80.3*	(38) *82.8*	(11) *83.9*
Nas.-alv. pt.	(27) 75.9	(37) 73.4	(10) 72.–
Diam. biz.	(26) 143.7	(37) 142.4	(12) 141.9
Facial index, upper	(26) *52.8*	(37) *51.6*	(10) *50.8*
Bas.-nas.	(26) 103.8	(39) 103.1	(11) 105.2
Bas.-alv. pt.	(27) 102.1	(38) 102.4	(9) 102.9
Orbital ht.	(27) 35.3	(39) 35.4	(12) 36.1
Nasal height	(26) 53.8	(38) 52.7	(12) 52.2
Nasal breadth	(25) 24.8	(39) 24.6	(12) 24.9
Nasal index	(26) *46.1*	(38) *47.0*	(12) *45.9*

The disappointing part of this work is the analysis and interpretation of the great mass of original data. Most of the effort in this direction is devoted to comparisons of the new data with the old, and without reference to American groups other than Eskimo and Paltacalo. This takes up 111 pages for the living and 48 for the skull. In his discussion of morphological types the author again ignores American Indian material and makes comparisons with Eskimos, Tasmanians, Australians, Ainu, New Caledonians, and Pseudo-Australoids. Interestingly, however, he concludes that the Fuegians, in spite of some primitive characters, are true Indians (p. 444).

The only statistical constants given are the mean and its probable error, the mean deviation (ε) and the coefficient of variation ($\omega = \frac{100\,\varepsilon}{M}$) for the combined skulls of all three tribes (67 males, 37 females). The somewhat obsolete and unfamiliar measures of variability here applied to data from three tribes make it difficult to estimate the true variability of the individual groups. For this reason I have calculated the standard deviations for the male Ona and Yahgan separately

and present them in the following table in comparison with North American Indians (von Bonin and Morant, Biometrika, '38):

	ONA		YAHGAN			AVER. FOR N. A. SERIES		MIN. IN N. A. SERIES	
Capacity	(22)	112.2	(33)	113.9		(6)[1]	99.5	(36)	75.1
Length	(26)	5.38	(39)	5.50		(14)	5.42	(33)	3.84
Breadth	(26)	4.16	(39)	4.69		(14)	4.80	(45)	3.37
Bas.-breg.	(26)	4.04	(38)	4.45		(14)	4.68	(30)	3.49
Nas.-alv. pt.	(27)	3.78	(38)	4.07	(3.77)[2]	(14)	3.94	(47)	3.37
Diam. biz.	(26)	4.36	(38)	5.59	(4.64)	(13)	5.41	(33)	3.38
Bas.-nas.	(26)	3.71	(39)	4.32		(6)	3.69	(33)	3.38
Bas.-alv. pt.	(27)	4.04	(38)	4.85		(5)	4.57	(39)	4.00
Orbital ht.	(27)	1.80	(39)	2.12		(9)	1.67	(30)	1.29
Nasal height	(26)	3.05	(39)	3.68	(3.02)	(14)	2.83	(53)	2.11
Nasal breadth	(26)	1.87	(39)	1.37		(14)	1.79	(40)	1.20
Cranial index	(26)	2.68	(39)	2.98		(14)	3.12	(42)	2.42
Nasal index	(26)	4.35	(39)	4.21	(3.80)	(14)	4.15	(40)	2.95

[1] In this column the figures in parentheses refer to numbers of series; in the other columns they refer to numbers of individuals.

[2] The standard deviations in parentheses result from the elimination of one Yahgan (1025/8 Lo.), which Flower has called a female but which Gusinde has included as a male.

This table brings out a point already noted by Hooton (Contr. Mus. Am. Ind., X) that the Ona are less variable than the Yahgan; it shows, too, that they are not unusual in their variability.

In calculating this table I have been impressed by the deficiencies in Gusinde's compilation. For instance, having to rely upon others to measure the crania in distant institutions, the author has had to accept their sexing and techniques. The sexing might not be the same in the cases of a few specimens seen alone and seen in the setting of the total series. This, undoubtedly, accounts for the inclusion of some females among the males, as the above table demonstrates (note the variability of capacity: range, 1200–1700 cc.). As for the personal error, this is brought out in the next table, wherein measurements on Yahgan skulls from the earlier literature are compared with those on the same skulls given by Gusinde's collaborators.

A further criticism concerns the selection of measurements. In spite of the great number of measurements taken on the skull, there is, for instance, only one of orbital breadth and this one (to maxillo-frontale) has not been reported often for other American material.

The last chapter contains four short sections: A. Craniological type analysis, by Stanislow Klimek; B. Heredito-biometric studies on Fuegians, by Robert Routil; C. The hair of the Fuegian, by Karl Saller; and D. The skeleton of the Fuegian, by Martin Gusinde. Klimek concludes from his application of the Czekanowski method that the Fuegian skull type is very similar to that of the Chumash of California and very different from that of Lagoa Santa and the Botocudos (the so-called paleo-American type). Moreover, he sees only Mongolian (yellow race) elements in the racial structure of the Fuegians and attributes their "Australoid" characters to convergence.

Personal error in measurements of Yahgan skulls.

	NEW SERIES VS. OLD SERIES	GRUBER-THALMANN VS. GARSON	MANTEGAZZA & REGALIA VS. MOCHI	G. SERGI VS. S. SERGI & GENNA
Length	(44) —1.1	(8) —0.6	(15) —2.5	(14) —0.8
Breadth	(44) —1.9	(8) —0.8	(15) —2.9	(14) —2.0
Bas.-breg.	(41) —1.1	(7) —0.7	(13) 0.0	(14) —2.1
Nas.-alv. pt.	(27) +0.6	(7) —1.9	....	(14) +2.6
Diam. biz.	(41) —0.1	(7) —0.4	(14) —0.4	(14) +0.2
Diam. front. min.	(42) —0.1	(7) +0.4	(15) +0.3	(14) —0.6
Orbital ht.	(43) +0.5	(7) 0.0	(15) +0.1	(14) +1.0
Nasal height	(43) —0.8	(7) +1.1	(15) —1.0	(14) —2.2
Nasal breadth	(43) —0.2	(7) +0.2	(15) —0.6	(14) —0.1

Routil finds nothing in the family material to distinguish the Fuegians from Europeans. Saller gives largely a factual report on the 90 hair samples (81 head, 9 pubic) and makes almost no racial comparisons. And finally, Gusinde summarizes the literature on the few skeletal parts that have reached museums in the past.

In spite of defects such as pointed out above, this work is bound to be very useful and probably long will remain the last word on the subject. Happily, also, it is a beautiful example of the printer's art.

T. D. STEWART.

CRANEOMETRÍA "PUEBLO." By MARÍA DE LAS MERCEDES CONSTANZÓ. An. Inst. Etnogr. Am., Univ. Nac. Cuyo, tomo 1, 1940, pp. 101–115.

RESTOS HUMANOS DE PAMPA GRANDE (SALTA). By MARÍA DE LAS MERCEDES CONSTANZÓ. An. Inst. Etnogr. Am., Univ. Nac. Cuyo, tomo 2, 1941, pp. 239–254.

DATOS SOBRE LA ANTROPOLOGÍA FÍSICA DE LOS ANTIGUOS HABITANTES DE CUYO. By MARÍA DE LAS MERCEDES CONSTANZÓ. An. Inst. Etnogr. Am., Univ. Nac. Cuyo, tomo 3, 1942, pp. 323–338 (with 2 folded tables).

ANTROPOLOGÍA CALCHAQUÍ. LA COLECCIÓN ZAVALETA DEL MUSEO ARGENTINO DE CIENCIAS NATURALES "BERNARDINO RIVADAVIA." By MARÍA DE LAS MERCEDES CONSTANZÓ. Rev. Inst. Antrop. Univ. Nac. Tucumán, vol. 2, no. 9, 1942, pp. 213–308.

Northwestern Argentina occupies a position in South American anthropology in many ways comparable to our own Southwest, as ten Kate long ago pointed out. Even if we limit our attention to the skeletal remains, a certain similarity is evident: The crania are practically all deformed; large numbers have been collected but with relatively little cultural data; and the anthropometric data published earlier are rather disappointing. Undoubtedly the deformity is the discouraging feature.

The four recent reports listed above by Doctora Constanzó, who is in charge of the Section of Anthropology in the Museo Etnográfico of the Faculty of Philosophy and Letters at the University of Buenos Aires, are further evidence both of this reported cultural and physical similarity and of the current activity of the Argentine anthropologists. As for the latter, indeed, it should be noted that both the "Anales" and the "Revista" in which Constanzó's work appears are within the first three volumes and are excellently printed.

Doctora Constanzó begins her series of publications with a description of twenty-eight "Pueblo" skulls obtained through exchange with the Heye Museum in New York. Of the true Pueblos represented there are eight from Arizona and eight from New Mexico. Of the remainder, which are erroneously characterized as the "eastern Pueblo branch," three are from Washington, one from Louisiana and eight from Tenneessee. The type of deformity is described for each specimen, but otherwise only average indices are given and these are for the combined sexes. She concludes that "Taking into account the contour, indices, deformation and capacity we must affirm . . . . that the "Pueblo" Indians belong to the American race called

Pueblo-andid, according to the diagnosis that Imbelloni has established for it. . . .''

The second paper concerns a small collection (eleven skulls, eight mandibles) obtained by Professor Aparicio in 1941 from caves and shelters along the Río Grande de la Pampa in the province of Salta. Tribe is unknown. Again she gives no individual or average measurements, but only averages for the indices and without regard to sex. She concludes that ''. . . . the remains from Pampa Grande also pertain to the same race [Pueblo-andid]. . . .''

The third paper deals with thirty-one skulls collected at various times and at various places in the provinces of San Juan and Mendoza. These two provinces, together with that of San Luis, constitute the colonial administrative district of Cuyo. Various tribes inhabited this area. This material is reported in detail by locality. As before, however, the summarized average indices disregard the sex distinction. ''In resume,'' she says, ''the examples are Andids . . . .''

The fourth and last paper, being the author's doctorate thesis, is more ambitious than the others. It deals with a large series from the socalled ''Calchaquí Valleys'' of northwestern Argentina. This is an area approximately 50 miles broad and 200 miles long, in a north-south direction, that constitutes the drainage basin of the Calchaquí and Santa Maria rivers. It was in this area than Manuel B. Zavaleta prior to 1907 collected at least 482 Indian skulls and a few long bones. This collection was divided nearly in half, 240 skulls going to the Kgl. Museums für Völkerkunde in Berlin, and 242 to the Museo Argentino de Ciencias Naturales in Buenos Aires. The part in Berlin was described in 1911 by Hugo Kunike (Arch. Anthrop., n.f. Bd. 10, pp. 203–225), and now Constanzó has described the other part. From historical sources it has been determined that Diaguita Indians occupied this area.

Before considering Constanzó's report we may note that Kunike was content to list the individual skull measurements and observations with scarcely any attempt at summary. Thus in order to obtain from his report average measurements by sex it is necessary to comb the text for the sex of individual specimens and then compute the averages from the lists. Also, Kunike seems to have measured face height to glabella instead of to nasion, and nasal height to the top of the aperture instead of to nasion.

In view of these deficiencies in Kunike's report, the further detailed data now supplied by Constanzó are most welcome. Unfortunately, however, she fails likewise to summarize the figures completely. For example, all of her averages are for males and females combined. Furthermore, she makes no attempt to combine her data

with those of Kunike, nor to compare the material from different sites, nor to treat the data statistically. In the latter connection a statistical sampling made by the reviewer yielded a standard deviation for the orbital index in males (excluding 4 indices between 106 and 125!) of 5.64 and for the nasal index of 4.63. Both of these are above average and require explanation.

Comparisons are made here, as in the other studies, with the sole purpose of showing that this group belongs among the "Pueblo-andids" of Imbelloni's classificatory scheme. It is regretable that some of the space used in this demonstration, as well as the 19½ pages used in listing the specimens were not devoted to more important analyses.

T. D. Stewart

EXPLORACIÓNES ARQUEOLÓGICAS EN QUIMSARUMIYOC Y HUACCANHUAYCO (CALCA). By Luis A. Llanos. Rev. Mus. Nac. Lima, tomo 10, no. 2, 1941, pp. 240–259.

ENSAYOS DE ANTROPOLOGÍA FÍSICA. LOS ANTIGUOS POBLADORES DEL CUZCO (REGIÓN DE CALCA). By Sergio A. Quevedo A. Rev. Mus. Nac. Lima, tomo 10, no. 2, 1941, pp. 282–309; tomo 11, no. 1, 1942, pp. 58–96.

Taken together, and from the standpoint of physical anthropology, these two reports on skeletal remains with cultural associations are among the most useful that have been produced thus far by Peruvian scientists. The value of these reports rests for the most part on the indications, brief though they may be, of the nature of the accompanying cultural objects (Llanos) and the identification of the anthropometric technique employed — in this case that of the Monaco Agreement (Quevedo). In view of Newman's discussion of Peruvian crania, appearing elsewhere in this number of the Journal, it will be useful to summarize here the findings of Llanos and Quevedo.

Quimsarumiyoc takes its name from three great boulders dominating the site and under one of which were located four pit-like ossuaries that yielded practically all the skeletal material recovered. This site, which is associated with the ruins known as Kcenta, is on the right side of the Huillcamayu valley, 1500 meters from the plaza of Calca, and 15–20 miles directly north of Cuzco. It will be recalled that the material described by MacCurdy, chiefly from Paucarcancha, and by Eaton, from Machu Picchu, is from this same general region but more to the northwest of Cuzco.

Unfortunately, Llanos does not summarize or discuss the cultural findings. From all indications, however, the pottery and metal

objects are Incaic (period ?). At the same time it is interesting to note that Chimu pottery from northern coastal Peru was recovered at Huaccañhuayco, the other site investigated nearby. The occurrence here of this foreign ware may be further evidence of the Inca custom of moving conquered peoples about — in this case from coast to highland. Thus there is as much uncertainty regarding the nature of this population as in the case of Paucarcancha and other sites described by MacCurdy. Since, however, Quimsarumiyoc was neither a religious center nor a fortification, and since the cultural remains are quite ordinary, its population, as represented in these ossuaries, was probably of the common people.

As usual in ossuaries, the bones were dissociated. The quantity may be judged from the fact that about 116 skulls were recovered, including twenty-four that had been trephined (21%). Quevedo has selected fifty-five of these skulls (thirty-two male, twenty-three female) for study (including eleven that had been trephined), the basis of selection being the better preserved adults. Although nothing is said about artificial deformity, there is no indication either in the measurements or illustrations that it was present. This is an unusual feature of this sample that deserves to be stressed.

A few of the cranial measurements are listed here for comparison with the figures given by Newman. In general there is fair agreement with the Paucarcancha series. The more marked divergences are in the facial measurements, particularly face breadth, nasal height and breadth, and orbital height. It seems likely that some peculiarities in technique may be involved here.

	MALE (32)	FEMALE (23)
Glabello-occipital length	178.5 ± 0.80	166.9 ± 0.82
Maximum breadth	132.6 ± 0.60	125.6 ± 0.71
Vertical height	136.2 ± 0.54	130.7 ± 0.55
Minimum frontal diameter	91.8 ± 0.45	88.7 ± 0.71
Basion-nasion	101.0 ± 0.52	93.2 ± 0.82
Basion-alv. pt.	95.6 ± 0.52	92.8 ± 0.42
Nasion alv. pt.	69.1 ± 0.47	62.4 ± 0.71
Diam. biz. max.	138.7 ± 0.67	126.4 ± 0.63
Nasal height	53.1 ± 0.23	48.4 ± 0.54
Nasal breadth	27.2 ± 0.32	24.3 ± 0.18
Orbital height	38.5 ± 0.25	34.9 ± 0.36
Orbital breadth	40.2 ± 0.47	37.8 ± 0.27
Cranial index	76.6	74.9
Length-height index	77.6	78.4
Length-breadth index	102.5	103.4
Upper facial index	49.5	49.6
Nasal index	49.2	51.0
Orbital index	91.7	95.0

The trephined skulls already mentioned are described in detail and illustrated. The operating technique seems to have been the same as that reported by MacCurdy, namely circular incision. Quevedo believes that therapy occasioned the operation in 83% of the cases.

In addition to the skulls, a few long bones (up to eleven for one kind and sex — side not stated) were measured for length in order to determine stature. Using Manouvrier's tables, Quevedo arrives at an average male stature of 161.8 cm. and a female stature of 146.7 cm. These figures are excessive as compared to available data on the living population (average male stature is generally under 160 cm.). For comparison I have computed stature by means of Pearson's formula *e* from MacCurdy's femur and tibia lengths: Male 154.5 cm., female 145.3 cm. These disagreements probably result from errors in sexing or the small size of the present sample.

These reports should encourage the authors to continue their good work and at the same time to attempt interpretations.

T. D. STEWART

NOTES

A NEW SOCIETY

The Inter-American Sciety of Anthropology and Geography was founded January 1, 1943, to fill a recognized need for such an organization. Already the response to the membership invitations has been so good that the success of the Society is practically assured.

The Society will publish a quarterly review, the first issue of which will appear early in 1943. The review will carry articles which have subject matter or method of broad Inter-American rather than local interest. It will publish summaries of recent work in areas or countries, discussions of research problems, abstracts of outstanding recent works, and news notes of personal and institutional activities. Publication will be primarily in English, Spanish and Portuguese, but contributions in other languages may be accepted.

A Temporary Organizing Committee has undertaken to establish and conduct the affairs of the Society until it can be put on a permanent basis. This has been necessary because an organization meeting cannot be held at the present time and because the Smithsonian Institution has provided special facilities to assist in the preliminary work. This Committee consists of Wendell C. Bennett, Yale University; George Vaillant, University of Pennsylvania Museums; Preston James, University of Michigan; Carl O. Sauer, University of California; S. W. Boggs, State Department; Julian Steward, Smithsonian Institution, and Ralph L. Beals, on leave from the University of California and now at the Smithsonian Institution. This Committee will function until December 31, 1944, when elective officers will assume control.

The Temporary Organizing Committee invites the membership of interested individuals, societies, and institutions. The following

types of membership have been created: 1. Life ($100); 2. Regular ($3.00 a year); 3. Student ($2.00 a year. Applications for student membership should be accompanied by a statement, signed by two instructors, attesting to the student status of the applicant. Members may remain in the student classification for only 3 years); 4. Affiliated ($3.00 a year. Open to societies and institutions, who will have the same privileges as Regular members and in addition may elect a member of the governing Council); 5. Institutional (no voting privileges; open to libraries and similar organizations).

Applications for membership, accompanied by dues for the first year, should be sent to Ralph L. Beals, Secretary of the Temporary Organizing Committee, Smithsonian Institution, Washington, D. C. Contributions to the review may be sent to the same address.

A NEW PERIODICAL

The Joint Committee on Latin American Studies is about to publish the first issue of a new periodical "*Notes on Latin American Studies in the United States.*" The major purpose of the "Notes" is to stimulate Latin American studies in the Humanities and Social Sciences and to provide a medium for the exchange of views and information. The publication will also seek to bring about closer relations between scholars in the Latin American field and the Joint Committee and its various sub-committees.

The "Notes" will appear semi-annually. Contributions and communications concerning editorial matters should be sent to Ralph L. Beals, Editor, Smithsonian Institution, Washington, D. C.

Subscriptions ($1.00 a year) and communications concerning business matters should be sent to Wendell C. Bennett, Executive Secretary, Joint Committee on Latin American Studies, 55 Hillhouse Avenue, New Haven, Conn.

A PRELIMINARY ANNOUNCEMENT

The Third Round Table Conference of the Mexican Anthropological Society is planned for the early or late summer of 1943. The exact date and place — somewhere in northern Mexico, perhaps

Durango or Tamaulipas — will be announced later. Subject of the discussion will be ''Northern Mexico and the relationship between the cultures of Middle America and those of the Southeast and Southwest of the United States.''

According to the tentative program, the Organizing Committee is hopeful of having present most of the leaders in this field. Physical anthropology of northern Mexico in respect to the three neighboring areas is to be considered by Doctor Borbolla. Regardless of whether the program can be carried out as provisionally outlined, this conference should be well worth attending.

Correspondence should be addressed to Daniel F. Rubín de la Borbolla, Secretario del Comité Organizador, 3a. Conferencia de Mesa Redonda, Calle de la Moneda no. 13, México, D. F., México.

THE MESETHMOID-PRESPHENOID RELATIONSHIPS IN THE PRIMATES

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ONE PLATE (TWO FIGURES)

Wood Jones ('23) has stated that in the anterior fossa of the human skull "the presphenoid bone and the mesethmoid articulate together over a wide area. In the Monkeys and the Anthropoid Apes (. . . . with the exception of the Orang) the mesethmoid is excluded from contact with the presphenoid by an ingrowth of the frontals between the two."

In checking this statement Gregory ('27) found that in the few young gorilla and chimpanzee skulls which he was able to examine "the ingrowths of the frontals from the sides do not disrupt the contact between the mesethmoid and the presphenoid but either overlap it slightly or restrict it to a narrow isthmus."

To this Wood Jones ('28 a) replied that the importance of the mesethmoid-presphenoid contact lies in the fact that it is a primitive mammalian feature, and as such is retained by man, while the frontal separation of the mesethmoid and presphenoid is a definite simian specialization. Therefore, argues Wood Jones ('28 b), the hominoid stock may be conceived as having separated "from the Old World monkey-great-ape stock before this latter stock had acquired these two . . . . simian specializations," that is, the fronto-temporal pterion and the mesethmoid-presphenoid contact.

I have already shown elsewhere that the spheno-parietal pterion in man is not a primitive but a very advanced character (Ashley Montagu, '33). Being stimulated by Wood

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Jones' interesting views relating to the significance of the mesethmoid-presphenoid contact in man, and its alleged absence (with the exception of the orang) in the great apes I commenced, in 1928, to make observations on the anterior cranial fossa in all primate crania available for inspection. Although many thousands of crania have passed through my hands during the 15 years which have since elapsed, I have to report the appalling fact that I have succeeded in finding less than 100 crania in which the relationship of the bones in the anterior cranial fossa was visible.

In many instances the sutures were obliterated, but in the large majority of cases inspection was rendered impossible because the skulls had not been sectioned. For these reasons I am able to report only upon the lamentably small number of seventy-eight anthropoid crania, and thirty-two other primate crania.

As I have already pointed out elsewhere (Ashley Montagu, '30) the few observations which have been made on platyrrhine and catarrhine monkeys do not support Wood Jones' statements concerning the character of the mesethmoid-presphenoid relationships. Thus, for example, in four out of a total of nine opened Alouatta crania examined by me at the British Museum (Natural History), the presphenoid articulated with the mesethmoid. In one skull of Brachyteles the presphenoid displayed a long median process which reached out and established contact with the mesethmoid. Interestingly enough, as Le Double ('06) and Augier ('31) have shown, this condition sometimes occurs in man. In fourteen skulls of the Old World monkey Semnopithecus [1] the frontals interrupted the contact between the mesethmoid and the presphenoid. In four skulls of Tarsius spectrum the antisphenoidal process of the frontal intervened between the mesethmoid and the presphenoid.

It would appear likely, therefore, that among the various species of the primates the relation of the bones in the anterior cranial fossa are characterized by a considerable amount of variability. If this is a fact, as there is every

[1] The record of the total number examined has, unfortunately, been lost.

reason to believe that it is, then it is an important one, for it renders such an explanation as Wood Jones ('29) has given of the relations of the bones in the anterior cranial fossa highly doubtful. Wood Jones may, of course, be perfectly correct in attributing these changes to the expanding brain, but such an explanation seems to me to be far too simple. I should be inclined to give more attention to the fact of variability in attempting any explanation of these relationships without denying the possible functional-structural relations. The relations and form of structures have too often been explained exclusively in terms of function. This is a tradition which morphologists have inherited from the nineteenth century. It is a pre-Mendelian tradition.

There are, for example, numerous structures in the human body which it would be exceedingly difficult to explain as owing their peculiar character to a particular change in function. Function does not always determine structure, on the other hand, it might with greater justice be said that structure determines function. It is extremely unlikely, for instance, that man's short canines, which are so much unlike the tusk-like homologues in the anthropoids, owe their existence to the fact that the early members of the Hominidae adopted new habits of using their teeth, habits which eventually resulted in the selection of those who best adapted themselves to the new way of functioning. It is, on the other hand, more probable that the reduced canines of the Hominidae owe their character to mutation in one or more genes (Ashley Montagu, '35, '36, '40). The mesethmoid-presphenoid relationships may have been altered in precisely the same manner in different species of primates and, of course, quite independently of one another. This is a possibility which certainly deserves to be considered. But let us now proceed to the facts.

Gibbon

Seven skulls of Hylobates and two of Symphalangus were examined, and none displayed the mesethmoid-presphenoid articulation (table 1). As in all anthropoid crania, with the

TABLE 1

Material examined.

COLLECTION	NO.	AGE	SEX	MESETHMOID-PRESPHENOID ARTICULATION	SPECIES
	Gibbon				
Acad. Nat. Sci. Phila.	5262	Juv.	♀?	—	H. pileatus
Acad. Nat. Sci. Phila.	12803	Adult	♂	—	H. nasutus
Am. Mus. Nat. Hist.	C.A. 11090	Adult	♂	—	S. syndactylus
Author's	2	Adult	♀	—	H. agilis
Mus. Comp. Zool. Harvard	12742	Adult	♂	—	H. lar leuciscus
Mus. Comp. Zool. Harvard	12745	Juv.	♂	—	H. lar leuciscus
Mus. Comp. Zool. Harvard	12746	Adult	♀	—	H. lar leuciscus
Mus. Comp. Zool. Harvard	27687	Adult	♀	—	S. syndactylus
Oxford University. Zool.			♂	—	H. sp.?
	Orang				
Acad. Nat. Sci. Phila.	2199	Juv.	♂?	+	....
Acad. Nat. Sci. Phila.	12191	Juv.	♀?	+	....
Acad. Nat. Sci. Phila.	13110	Juv.	♀	+	....
Acad. Nat. Sci. Phila.	13148	Juv.	♂	+	....
Am. Mus. Nat. Hist.	C.A. 17350	Juv.	♀	+	....
Am. Mus. Nat. Hist.	C.A. 18010	Adult	♂?	+	....
Author's	3	Juv.	♀?	+	....
Mus. Comp. Zool. Harvard	413	Juv.	♀	+	....
New York Univ. Dentistry	1	Juv.	♀?	+	....
New York Univ. Dentistry	3	Juv.	♂	+	....
Roy. Coll. Surgeons. London	39		♂	+	....
U. S. Nat. Mus. Washington	49848	Adult	♀	+	....
U. S. Nat. Mus. Washington	49849	Juv.	♂	+	....
U. S. Nat. Mus. Washington	49851	Adult	♀	+	....
U. S. Nat. Mus. Washington	49852	Juv.	♀	+	....
U. S. Nat. Mus. Washington	49853	Adult	♂	+	....
U. S. Nat. Mus. Washington	49855	Adult	♂	+	....
U. S. Nat. Mus. Washington	49856	Adult	♂	+	....
U. S. Nat. Mus. Washington	49857	Adult	♀	+	....
U. S. Nat. Mus. Washington	49859	Adult	♂	+	....
U. S. Nat. Mus. Washington	49861	Adult	♀	+	....
U. S. Nat. Mus. Washington	49864	Adult	♀	+	....
U. S. Nat. Mus. Washington	49878	Juv.	♂	+	....
U. S. Nat. Mus. Washington	153817	Juv.	♀	+	....
U. S. Nat. Mus. Washington	153818	Adult	♂	+	....
U. S. Nat. Mus. Washington	153822	Adult	♀	+	....

TABLE 1 — (*Continued*)

COLLECTION	NO.	AGE	SEX	MESETHMOID-PRESPHENOID ARTICULATION	SPECIES
	Gorilla				
Acad. Nat. Sci. Phila.	2154	Adult	♀	—	....
Acad. Nat. Sci. Phila.	3143	Juv.	♂	+	....
Acad. Nat. Sci. Phila.	3144	Juv.	♂	—	....
Acad. Nat. Sci. Phila.	3145	Juv.	♂	+	....
Am. Mus. Nat. Hist.	C.A. 56	Juv.	♀	+	....
Am. Mus. Nat. Hist.	54084	Juv.	♂	+	....
Author's	1	Adult	♀	+	....
Mus. Comp. Zool. Harvard	9490	Adult	♀	—	....
Mus. Comp. Zool. Harvard	20089	Juv.	♀	—	....
Roy. Coll. Surgeons. London	2253	Adult	♀	+	....
Roy. Coll. Surgeons. London	5176(25)		♂	+	....
Roy. Coll. Surgeons. London			♀	—	....
Roy. Coll. Surgeons. London			♀	—	....
U. S. Nat. Mus. Washington	174711	Adult	♀	—	....
U. S. Nat. Mus. Washington	174720	Adult	♂	—	....
U. S. Nat. Mus. Washington	176225	Adult	♂	—	....
U. S. Nat. Mus. Washington	239884	Adult	♂	+	Gorilla beringei
	Chimpanzee				
Acad. Nat. Sci. Phila.	3143	Juv.	♂?	+	....
Acad. Nat. Sci. Phila.	11812	Juv.	♂?	+	....
Acad. Nat. Sci. Phila.	12804	Juv.	♂	+	....
Am. Mus. Nat. Hist.	C.A. 189	Juv.	♂?	+	....
Am. Mus. Nat. Hist.	2058	Juv.	♀?	+	....
Am. Mus. Nat. Hist.	C.A. 35121	Juv.	♀	+	....
Am. Mus. Nat. Hist.	C.A. 35550	Adult	♀	+	....
Am. Mus. Nat. Hist.	51376	Adult	♀	+	....
Author's	2	Juv.	♂?	+	....
Mus. Comp. Zool. Harvard	9316	Juv.	♂?	+	....
Mus. Comp. Zool. Harvard	10578	Juv.	♀?	+	....
Mus. Comp. Zool. Harvard	9494	Adult	♀?	+	....
New York Univ. Dentistry	4	Juv.	♂?	+	....
Oxford University. Zool.			♂	+	....
Roy. Coll. Surgeons. London	4		♂	+	....
Roy. Coll. Surgeons. London	6		♂	+	....
Roy. Coll. Surgeons. London	9		♂	+	....
Roy. Coll. Surgeons. London	10.4		♀	+	....
Roy. Coll. Surgeons. London			♂	—	....
Roy. Coll. Surgeons. London			♂	—	....
Roy. Coll. Surgeons. London			♂	—	....
U. S. Nat. Mus. Washington	17634	Juv.	♂?	+	....
U. S. Nat. Mus. Washington	49893	Juv.	♂	+	....
U. S. Nat. Mus. Washington	176233	Juv.	♂?	+	....
U. S. Nat. Mus. Washington	176237	Juv.	♂?	+	....
U. S. Nat. Mus. Washington	220327	Adult	♂	—	....

exception of the orang, there appears to be a tendency in the gibbon for the presphenoid to develop a median process which may possibly, in some instances, reach the mesethmoid, as is occasionally the case in the chimpanzee and in the gorilla. The cribriform plate is narrow-oval in shape, and is situated upon a plane below the level of the external naso-frontal suture. In the specimens which I examined no crista galli was present. As a rule the articulation of the frontals between the mesethmoid and presphenoid would be quite considerable were it not for the presence of the presphenoid process which frequently reduces that articulation by half.

Orang-outang

Twelve male and fourteen female orang skulls of all ages were examined, and all displayed the mesethmoid-presphenoid articulation (table 1). The orang is the only one of the anthropoids which usually shows the mesethmoid-presphenoid articulation. The orang skull, as is well known, is characterized by a remarkable naso-frontal-ethmoidal stenosis. This is often perceptible on the facial aspect of the skull in the complete absence of the nasal bones, or in their extreme reduction. This extreme narrowing actually appears to have the effect of producing a considerable shortening of the whole ethmoid complex of cells, with a compensatory enlargement of the maxillary sinuses and an extreme reduction, almost to "insignificance," of the sphenoidal sinuses (Cave and Haines, '40). Hence, in the anterior cranial fossa the cribriform plate presents the shortest antero-posterior diameter to be found in any of the higher primates. Nevertheless, the presphenoid and lesser wings of the sphenoid present by far the largest antero-posterior diameters of any of the primates!

What appears to have occurred is that the ethmoid complex has been pushed, as it were, downwards and backwards, while the lesser wings, which have grown markedly and uniquely forwards to contribute to almost the whole of the formation of the posterior-superior portion of the orbital

roof, meet the mesethmoid in a broad articulation which embraces the lateral borders of the posterior third of the cribriform plate. The cribriform plate is set in a depression in the anterior cranial fossa at a level reaching more than half to three-fourths of the distance down from the nasion towards the superior borders of the pyriform aperture. The crista galli is generally represented by a very inconspicuous ridge or process.

The mesethmoid-presphenoid articulation in the orang is far more considerable than in any other primate not excluding man.

Gorilla

In the gorilla the form of the mesethmoid closely resembles that of the orang, while the presphenoid is more like that of man; but in the gorilla the frontals, in some 53% of cases, intervene between mesethmoid and presphenoid to articulate in the mid-plane with one another.

Nine female and eight male gorilla skulls, almost all of whom were of adult age, were examined (table 1). In eight, or 47.0% of cases, the mesethmoid-presphenoid contact occurred. In two out of these eight cases the contact was established in one instance (AMNH 54084) by means of a narrow process originating from the mesethmoid, while in the other instance (MFAM 1) the process was derived from the presphenoid. In one case (ANSP 3143) the contact was of the characteristic human type. In the remaining five cases the contact was established by a broad blade of bone which almost, but not quite, eliminated the frontals from articulating posteriorly with part of the mesethmoid.

In the gorilla the orbital plates of the frontals perform the functions which in the orang are exercised by the mesethmoid and the lesser wings of the sphenoid. Such differences in the relations of the bones seem to me to be of more than passing interest for they strikingly illustrate the fact that the same bones may in different genera play very different roles.

This has already been clearly demonstrated in the changing relations of the bones at the pterion (Ashley Montagu, '33), and in the remarkable transformation of the relations of the bones supporting the incisor teeth in man, the premaxilla and maxilla (Ashley Montagu, '35, '36, '40).

As in the orang the cribriform plate is situated in a depression between the rather convexly curved frontals, at a level half way between the external naso-frontal suture and the superior borders of the pyriform aperture. The crista galli is generally represented by a slight elevation of the ethmoid.

Chimpanzee

Nineteen male and seven female chimpanzee skulls were examined (table 1). The mesethmoid-presphenoid contact was present in fifteen males and in the total number of seven females examined, a total of 84.6% of mesethmoid-presphenoid contacts. In at least three of these cases (AMNH. C.A. 35121, AMNH. C.A. 35550, AMNH 2058) — all probably female skulls — the contact was established through the agency of a narrow presphenoid process. It is more than likely that several of the other skulls exhibiting the mesethmoid-presphenoid contact had this articulation established in the same manner, my notes are, however, not detailed enough to permit of a more exact statement of the conditions other than that a mesethmoid-presphenoid contact was present.

The form of the presphenoid in the chimpanzee most closely resembles that of man, except that it is generally characterized by a substantial median chiasmatic process, and the lesser wings of the body are frequently relatively short. However, a great deal of variability is present in these characters.

The cribriform plate is, in shape, very like the same structure in man, and a well developed crista galli is generally present. The cribriform plate is, however, as in the other anthropoids, situated in a depression between the well-arched frontal bones at a level about half way between the external

nasofrontal suture and the superior borders of the pyriform aperture.

DISCUSSION

Occasionally in the human infant, and very rarely in the adult human skull (Staurenghi, 1895), the frontals superficially intervene between the mesethmoid and presphenoid (fig. a), while among those anthropoids which normally show variable frequencies of this condition in the adult, namely, the gorilla and chimpanzee, in the chimpanzee, at least, the infant skull frequently shows the broad mesethmoid-presphenoid contact in precisely the same relations characteristic of the normal human skull (fig. b). In the infant gorilla the intervening frontal processes are often very narrow. Surely there is in these facts more than the suggestion of a strong family likeness. As Gregory ('28) has remarked, the study and comparison of these conditions should "convince unprejudiced osteologists that the likenesses are far-reaching and profound." Gregory ('34) has suggested that all these facts lend a certain amount of support to Bolk's foetalization theory, namely, that many human characteristics started from conditions similar to those preserved in foetal apes, which foetal characters thereafter became over-emphasized in man but went on to give rise to the later specialized conditions seen in adult apes. It may, however, be that the withdrawal of the frontal processes in the adult human skull is a relatively late acquisition due to the great encephalization of the frontal region. But whatever the changes which have taken place in the giant primates, and whatever their causes, the essential likeness remains. The orang in 100% of cases, the chimpanzee in 84.6%, and the gorilla in 47.0% of cases, in one form or another, still show contact between the mesethmoid and the presphenoid.

It will, therefore, be seen that Wood Jones' inferences and conclusions regarding the significance of the mesethmoid-presphenoid relationships in the anterior cranial fossa in the great apes and in man receive no support from the facts.

When one compares the facial skeleton of the monkeys in general with that of the anthropoids a clue is obtained to the probable explanation of the mesethmoid-presphenoid relationships in the primates.

In the platyrrhine and catarrhine monkeys the frontal bones generally occupy a broad area between the mesethmoid and presphenoid. This would appear to be directly related to the fact that owing to the great prognathism of these animals the ethmoidal complex is perforce situated considerably more anteriorly in relation to the anterior cranial fossa than is the case in the more orthognathic apes.

Interestingly enough the upper half of the face is, in the orang, by far the most vertically oriented to be found in any of the apes, whereas in the gibbon this part of the face is oriented at an angle of about 45 degrees from the Frankfurt Plane. The orang shows 100% of mesethmoid-presphenoid contacts and the gibbon shows none! In the chimpanzee, in which this angle approaches the perpendicular more nearly than it does in the gorilla, mesethmoid-presphenoid contacts are more frequent than in the latter.

In man, in whom orthognathism has reached its extreme degree of development, the mesethmoid-presphenoid contact is the rule. In view, therefore, of the close relationship of the structures composing the facial portion of the head, it is obvious that the reduction in the projection of the jaws must have been accompanied by a necessary re-alignment of the ethmoidal complex. Whatever may be the details involved in the processes which brought this about, it is clear that, to speak in crassly mechanistic terms, these processes probably occurred in something like the following manner:

The ethmoid was "pushed" backwards and upwards with the result that the perpendicular plate of the ethmoid rose between the cribriform plate to project — as the crista galli — appreciably into the anterior cranial fossa, and the cribriform plate came to lie upon a level with the external nasofrontal suture — actually half, or almost half, again as high as in any of the anthropoids.

The "postero-superiorization" of the ethmoid complex caused the posterior portion of the ethmoid — the mesethmoid — to border immediately upon the presphenoid and thus disarticulate the ingrowth of the frontals.

The fact that in an occasional human skull the frontals will grow over the mesethmoid and superficially appear to disrupt the mesethmoid from contact with the presphenoid, may be taken to indicate that the energy relations determining the form of the frontal in the spheno-ethmoidal region still tend to exhibit the character of an ancestral pattern of growth.

From every viewpoint, therefore, the evidence strongly suggests that the relations of the bones in the anterior cranial fossa of man indicate an origin from a primate stock which was also ancestral to the anthropoids.

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LITERATURE CITED

ASHLEY MONTAGU, M. F. 1930 The tarsian hypothesis and the descent of man. J. Roy. Anthrop. Inst., vol. 60, pp. 335–362.

——— 1933 The anthropological significance of the pterion in the primates. Am. J. Phys. Anthrop., vol. 18, pp. 159–336.

——— 1935 The premaxilla in the primates. Quart. Rev. Biol., vol. 10, pp. 32–59, 181–208.

——— 1936 The premaxilla in man. J. Am. Dent. Assoc., vol. 23, pp. 2043–2057.

——— 1940 The significance of the variability of the upper lateral incisor teeth in man. Human Biology, vol. 12, pp. 323–358.

AUGIER, M. 1931 Squelette céphalique. In P. Poirier et A. Charpy, Traité d'Anatomie humaine, Paris, I.

BROOM, R. 1926 On the mammalian presphenoid and mesethmoid bones. Proc. Zool. Soc., London, vol. 1, p. 257.

CAVE, A. J. E., AND R. W. HAINES 1940 The paranasal sinuses of the anthropoid apes. J. Anat., vol. 74, pp. 493–523.

GREGORY, W. K. 1927 The origin of man from the anthropoid ape stem — when and where? Proc. Am. Phil. Soc., vol. 66, p. 453.

——— 1928 Reply to Professor Wood Jones' note: Man and the anthropoids. Am. J. Phys. Anthrop., vol. 12, pp. 253–256.

——— 1934 Man's Place Among the Anthropoids. Oxford, pp. 93–94.

LE DOUBLE, A.-F. 1906 Traité des variations des os de la face de l'homme. Paris.

STAURENGHI, C. 1895 Appunti di osteologia sulla fossa anteriore della base del cranio del'uomo e dei mammiferi. Bollet. Soc. med.-Chir. Pavia, Milano.

WOOD JONES, F. 1923 The Ancestry of Man. Brisbane, pp. 26–27.

——— 1928 a Man and the anthropoids. Am. J. Phys. Anthrop., vol. 12, pp. 245–250.

——— 1928 b Reply to Doctor Gregory. Am. J. Phys. Anthrop., vol. 12, pp. 251–252.

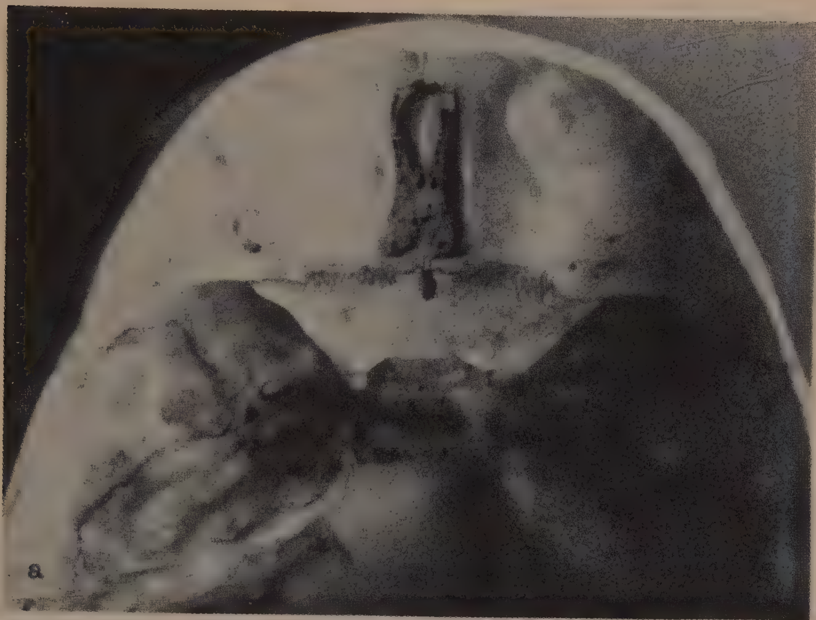
——— 1929 Man's Place Among the Mammals. London, pp. 337–339.

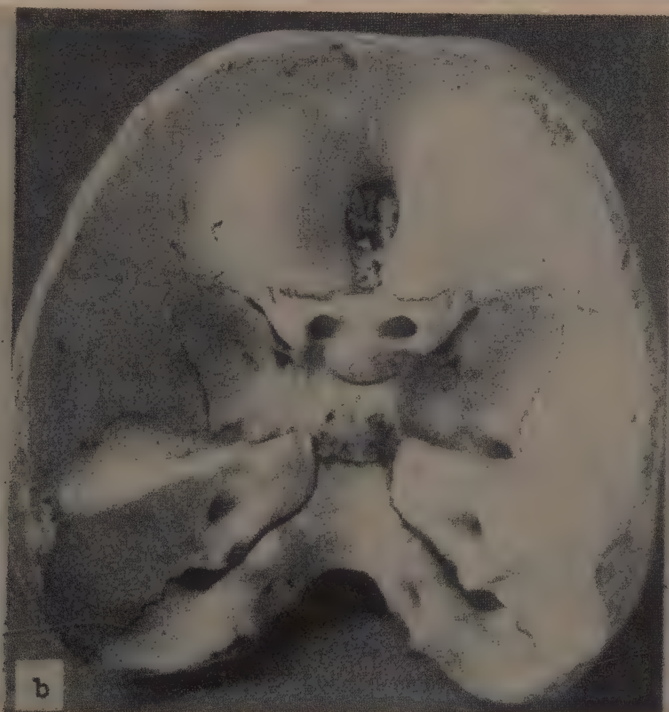
PLATE 1

EXPLANATION OF FIGURES

a Showing the mesethmoid-presphenoid contact incompletely interrupted by two small frontal processes. Skull of a 4-year-old Indian child from Edmonton, Alberta. Author's collection.

b Showing the mesethmoid-presphenoid contact in a juvenile chimpanzee, Pan sp? ♂. U.S.N.M. 498933.


a


b

DISTRIBUTION OF CRANIAL HEIGHT IN SOUTH AMERICA

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TWO FIGURES

In summarizing in 1940 some of the historical implications of physical anthropology in North America I emphasized among other things the distribution of the mean height index. According to the figures that I was able to assemble, an average index below 83, which indicates a relatively low skull, is unknown east of the Mississippi River, and west of this river is restricted largely to the Siouan, Caddoan and Athapascan tribes. I suggested that this distribution of low-headedness in North America might be due to the late arrival of these people on the continent. This interpretation is compatible with the geographical location of these people, who occupy positions near, or along, the probable migration route from Bering Strait. ''In this connection,'' I added (pp. 43–44), ''it is perhaps significant that low-headedness is widespread among both the modern and neolithic peoples of Siberia [Hrdlička, '42] and, on the other hand, that groups with comparable low-headedness are unknown in South America (cf. Dixon, '23).'' My reliance upon Dixon for specific information on head height in South America was a mistake, for, as I pointed out in the same paper (p. 24), Dixon gave little attention to head height even though the altitudinal index was essential to his analytical scheme.

Unfortunately, I did not know in 1940 that both the length-height (altitudinal) and the breadth-height indices had been summarized in an admirable manner for the whole western hemisphere 10 years prior to the appearance of Dixon's book.

In 1912–1913 the Italian anthropologist G. L. Sera published a long paper (261 pp.) on "the height of the skull in America." This paper, which is remarkable for the completeness of its utilization of the published data up to that time, discloses the existence of extreme low-headedness in South America comparable to that in North America.

Since Sera's finding is contrary to what in 1940 I believed to be true, it is desirable now to see whether this fact vitiates my earlier interpretation of the conditions in North America or whether the two can be brought into alignment. In order to facilitate comparison with South America the data should be presented in the form of the mean height index. The advantage of using the mean height index rather than either the length-height or the breadth-height index alone in general surveys of this kind has been discussed elsewhere (Stewart, '42).

My reason for not using Sera's data requires a brief explanation of his method. For each area or site he plotted the individual length-breadth and length-height indices on a grid and showed by means of cross lines the arbitrary classification of the height indices. This scheme requires a great many diagrams and does not lend itself to condensation or average figures. Also, Sera included indices derived from deformed skulls and from the living, neither of which are comparable with those on the normal skull and hence distort the picture.

The accompanying map (fig. 1) shows the locations of the undeformed cranial series that have been utilized in the present study. The sources of these series are listed in table 1. The lack of data for large areas of the southern continent is due chiefly to two factors: poor preservation and artificial deformity. Little material has been recovered from the rain forest areas, especially the Amazon basin, because bone soon disintegrates under the humid conditions of these parts. On the other hand, artificial cranial deformity was practiced along the greater part of the northern and western coasts as well as in parts of the neighboring highlands. Fortunately,

most published reports include lists of individual measurements from which the mean height indices can be computed.

The available mean height indices are listed in table 2 in descending order of the averages from highest to lowest. Some groups, unfortunately, are too small in number to be fully representative, but have been included for the valuable indication that even these small numbers give. The percentage

Fig. 1 Outline map of South America showing the localities represented by the cranial series used in this study. For identification of the numbers see table 1.

TABLE 1

List of undeformed cranial series used in the present study and their sources.

NO.	LOCALITY OR TRIBE	AUTHOR
1	Cerro de Luna, Venezuela	Marcano, 1893 b
2	Ipi-Iboto, Venezuela	Marcano, 1893 b
3	Cucurital, Venezuela	Marcano, 1893 b
3 a	Piaroa (Venezuela)	Marcano, 1890 a
4	Valleys of Aragua and Caracas, Venezuela	Marcano, 1893 a
5	Cuica and Timote (Venezuela)	Marcano, 1891
6	Goajiro (Colombia-Venezuela)	Marcano, 1890 b; Virchow, 1886
7	Near Bogota, Colombia	Broca, 1876
8	Paltacalo, Ecuador	Rivet, '08
9	Paraná delta, Argentina	Torres, '11
10	Río Negro, Argentina	Marelli, '13
11	Río Chubut, Argentina	Marelli, '13
12	Late Araucano (Argentina)	Marelli, '13; ten Kate, 1892
13	Araucano (Chile)	Latcham, '04 b
14	Near Norquin, Argentina (Araucano?)	Virchow, 1894
15	Near Lakes Colhue and Musters, Argentina	Verneau and de la Vaulx, '02
16	Near Lake Buenos Aires, Argentina	Imbelloni, '23
17	Ona (Tierra del Fuego)	Gusinde, '39; Hrdlička, '11
18	Yahgan (Tierra del Fuego)	Gusinde, '39; Hrdlička, '11; Hultkrantz, 1898; ten Kate, '04
19	Alacaluf (Tierra del Fuego)	Gusinde, '39; Hyades and Deniker, 1891; Mantegazza and Regalia, 1886; Mehnert, 1893; ten Kate, '04; Turner, 1884
20	San Damian, Peru	Newman, '43; manuscript
21	Chancay, Peru	Newman, '43; manuscript
22	Chicama, Moche and Virú valleys, Peru	Stewart, '43
23	Paucarcancha, etc., Peru	MacCurdy, '23
23 a	Machu Picchu, Peru	Eaton, '16
24	Lagoa Santa, Brazil	Bastos de Avila; Hansen, 1888, Pöch, '38; Walter, Cathoud and Mattos, '37
25	Botocudo (Brazil)	Canestrini and Moschen, 1879; Ehrenreich, 1887; Fridolin, 1898; Hansen, 1888; Lacerda and Peixoto, 1876; Rey, 1880; Rodrigues Peixoto, 1885; Schaaffhausen, 1877, 1879–1880; Sergi, 1891; Spengel, 1874; Virchow, 1874 b; Wieger, 1884; Zimmerman, '35
26	Imbabura, Ecuador	Jijón y Caamaño, '12
27	Shellmounds, Brazil	Lacerda, 1885; Virchow, 1872, 1874 a
28	Coquimbo Bay, Chile	Latcham, '04 a

distribution of the individual measurements in three arbitrary classes furnishes a useful check on the composition of the series. This arrangement follows that used in presenting the North American data (Stewart, '40, table 1).

TABLE 2

Mean height index, arranged in the descending order of the averages (both sexes).

SERIAL NO.	LOCALITY OR TRIBE	NO. OF SPECIMENS	DISTRIBUTION			AVERAGE
			–80.4	80.5–83.4	83.5–	
			%	%	%	
27	Shellmounds, Brazil	11	..	18.2	81.8	89.1
9	Paraná delta, Argentina	46	..	...	100.0	88.9
26	Imbabura, Ecuador	5	..	...	100.0	87.3
28	Coquimbo Bay, Chile	5	..	20.0	80.0	86.8
23	Paucarcancha, Peru	102	3.9	11.8	84.3	86.7
25	Botocudo (Brazil)	48	6.2	6.2	87.5	86.6
8	Paltacalo, Ecuador	11	?	?	?	86.3
10	Río Negro, Argentina	83	4.8	20.5	74.7	86.1
13	Araucano (Chile)	31	6.5	12.9	80.6	85.6
22	Chicama, Peru	118	2.5	21.2	76.3	85.5
14	Norquin, Argentina	23	4.3	26.1	69.6	85.5
24	Lagoa Santa, Brazil	13	7.7	15.4	76.9	85.4
15	Near Lakes Colhue and Musters, Argentina	10	?	?	?	85.2
7	Near Bogota, Colombia	3	..	...	100.0	84.7
12	Late Araucano (Argentina)	72	12.5	20.8	66.7	84.6
11	Río Chubut, Argentina	46	10.9	21.7	67.4	84.4
21	Chancay, Peru	44	?	?	?	84.0
5	Cuica and Timote (Venezuela)	6	16.7	16.7	66.6	83.6
18	Yahgan (Tierra del Fuego)	56	17.9	37.5	44.6	83.1
19	Alacaluf (Tierra del Fuego)	24	8.3	54.2	37.5	82.9
20	San Damian, Peru	122	22.1	38.5	39.3	82.7
23 a	Machu Picchu, Peru	40	27.5	30.0	42.5	82.6
17	Ona (Tierra del Fuego)	35	22.9	57.1	20.0	81.9
3 a	Piaroa (Venezuela)	10	40.0	40.0	20.0	80.6
4	Valleys of Aragua and Caracas, Venezuela	16	50.0	31.2	18.8	80.6
3	Cucurital, Venezuela	40	55.0	35.0	10.0	80.0
16	Near Lake Buenos Aires, Argentina	2	50.0	50.0	...	79.8
6	Goajiro (Colombia-Venezuela)	16	43.8	56.2	...	79.8
1	Cerro de Luna, Venezuela	78	60.3	25.6	14.1	79.7
2	Ipi-Iboto, Venezuela	42	73.8	19.0	7.1	76.5

The range of the averages thus shown, 89.1 to 76.5, compares with a North American range of 88.2 to 76.9 (twenty-nine groups), which is remarkably similar. Indeed, this similarity becomes more evident when it is considered that average mean height indices above 89 have been reported for North America — generally east of the Mississippi River — since my list was published (Hrdlička, '40).

Coming now to the main point of this arrangement, namely, the location of the low headed peoples in South America, it will be seen that an arbitrary line drawn at the level of index 83 divides the list into two geographical groups, one of which is high headed and the other low headed. Most of the low-heads in the lower half of the list come from a relatively compact area in the north (fig. 2)[1], whereas the high-heads of the upper half of the list cover the rest of the continent except for an isolated area of moderate low-headedness at the southern tip of the continent — chiefly the Ona and Alacaluf, and perhaps the Yahgan. The northern area seems to involve mainly the Arawak and Carib linguistic groups, but also some of the smaller groups like the Piaroa and perhaps the Timote. The low-headedness in the highlands of Peru is somewhat of a puzzle, but as Newman ('43, p. 40) points out, these sites are near the headwaters of the Amazon and there may have been some intermixture here.

It should be noted also that among the high-heads is included a group for which a considerable antiquity has been claimed, namely, Lagoa Santa. The skull of Fontezuelas from Patagonia, described by Hansen (1888), for which also a considerable antiquity has been claimed, has a mean height index of 87.2. Another putatively ancient skull, from Punin, central Ecuador (Sullivan and Hellman, '25), is low headed as the basion is now restored — 78.0. These findings, although somewhat contradictory and open to varying interpretation be-

[1] Additional mean height indices which have a bearing on the extent of the northern area inhabited by the low-heads is supplied by two catalogues of crania (Flower, '07; Broesike, 1880): Macushi (ca. 4°N, 61°W) — 76.9, 78.1, 81.6; Arawaks of the Guianas — 76.4, 79.5, 80.3, 81.2.

cause of the disputed antiquity, nevertheless in the majority are characterized by high-headedness.

The fact that the bulk of the low headed peoples are near the northern coast of South America seems to me to be significant. If we adhere to the interpretation used to explain the North American distribution, this easily accessible area is one of the places where we would look for late immigrants

Fig. 2 Generalized distribution of the extremes of the mean height index of the skull in South America based on the averages given in table 2.

into the southern continent. If, then, these southern low-heads represent such a late immigration, they must have come by way of Central America and left remnants or colonies along the way.[2] In support of this theory there is little evidence, but that little seems very significant. I can point only to the measurements of eight recent Maya skulls from Yucatan (including three children) published by Hrdlička ('26, table 2). The mean height index for this group averages 76.9 and only two of the individual indices are high enough to reach the middle class (80.5–83.4). Unfortunately, Central America has yielded little in the way of well preserved skulls free from artificial deformity, so it may be difficult to establish the cranial types of the other peoples of this region.

The fact that the distribution of low-headedness on the two continents is nearly continuous appears to support my theory. It is supported also by the fact that most of the skulls believed to be ancient in South America, like those in North America, are high headed. I am not aware of any ethnological evidence bearing on this matter. Also, I cannot explain such exceptionally located low headed groups as those at the southern tip of South America. Nevertheless, the distribution of extreme low-headedness seems to me to be too regular and too extensive to have resulted from hybridization due to the mixture of diverse types, as Neumann ('42) has suggested.

The only other explanation that I know to have been advanced is that by Sera ('12–'13). As I have stated, Sera recognized essentially the same distribution of head height in South America that I have here described. However, he set up four zones paralleling the long axis of the continent: (1) highest heads along the west coast, (2) moderately high heads in the Andes, (3) low heads in the north-central lowlands, and (4) high heads again in the highlands of eastern Brazil. On the basis of these zones Sera developed an elaborate and somewhat fantastic theory involving climatology.

[2] The migrations by way of the Antilles appear to have been only in a northward direction, according to the archeological evidence.

He would have the platycephalics develop in the Andes during the glacial period and in the postglacial period be forced into the eastern lowlands by the high headed peoples moving up from the coast. Sera was thus trying to apply to America a theory that had been used to explain certain distributions of head height in Europe. This theory as here applied has little to recommend it.

Finally, I should like to point out the general correspondence between the distributions of low-headedness and low stature in North, South and Central America (cf. Steggerda, '32, '43). In North America the lowest average statures (160–164.9 cm. in males) occur west of the Mississippi River and extend into Mexico. Still lower statures (155–159.9 cm. in males) occur in Central America. These two classes of stature overlap in the area occupied by the South American low-heads. This near identity of distribution is too striking to be entirely fortuitous. Incidentally, the racial types of the American Indian set up by von Eickstedt and Imbelloni cut across these distributions illogically, which is further evidence that these speculations are based upon scanty evidence (cf. Stewart, '43).

SUMMARY

In 1940 I suggested that the North American low-heads represent a relatively late migration onto the continent from Asia and supported this view with the statement that there appeared to be no comparable low-headedness in South America. Further study now reveals the presence of low headed peoples in South America, located mainly in the northern parts. The present report gives this evidence in the form of the mean height index and arranged like that already supplied for North America.

The fact that the modern Maya of Yucatan also are low headed, according to limited available data, suggests a more or less continuous distribution of low-headedness from western North America through Central America into northern South America. The continuity of this distribution, together with the absence of low-headedness in most of the

putatively ancient skulls of both continents, supports, if anything, the explanation already advanced for the North American distribution of this trait.

LITERATURE CITED

BASTOS DE AVILA, J. Anthropometry of the Indians of Brazil. Manuscript in the Bureau of American Ethnology.

BROCA, PAUL 1876 Sur deux séries de crânes provenent d'anciennes sépultures indiennes des environs de Bogota. Bull. Soc. Anthrop. Paris, 2nd ser., vol. 11, pp. 359–373. (Also in International Congress of Americanists, Compte-Rendu I ses., Nancy, 1875.)

BROESIKE, G. 1880 Das anthropologische Material des Anatomischen Museums der Königlichen Universität, Berlin. Anthrop. Samml. Deutsch., pt. 5, 87 pp.

CANESTRINI, GIOVANNI, AND LAMBERTO MOSCHEN 1879 Sopra due crani di Botocudi. Atti Soc. Veneto-Trentina Sci. Nat. Res. Padova, vol. 6, pp. 77–90.

DIXON, R. B. 1923 The racial history of man. C. Scribner's Sons, N. Y., 583 pp.

EATON, GEORGE F. 1916 The collection of osteological material from Machu Picchu. Mem. Conn. Acad. Arts and Sci., vol. 5, 96 pp.

EHRENREICH, PAUL 1887 Ueber die Botocudos der brasilianischen Provinzen Espiritu Santo und Minas Geraes. Ztschr. f. Ethnol., vol. 19, pp. 1–80.

FLOWER, WILLIAM HENRY 1907 Catalogue of the specimens illustrating the osteology and dentition of vertebrated animals, recent and extinct, contained in the Museum of the Royal College of Surgeons of England, pt. 1, 2nd ed., 433 pp.

FRIDOLIN, JULIUS 1898 Amerikanische Schädel. Arch. f. Anthrop., vol. 25, pp. 397–412.

GUSINDE, MARTIN 1939 Anthropologie der Feuerland-Indianer. III. (pt. 2) Anthropologie. Wien-Mödling, 511 pp.

HANSEN, SØREN 1888 Lagoa Santa Racen. En anthropologisk Undersøgelse af jordfundne Menneskelevninger fra brasilianske Huler. Med et Tillaeg om det jordfundne Menneske fra. Pontimelo ved Rio de Arrecifes, La Plata. E Museo Lundii, Copenhagen, vol. I, no. 5, pp. 1–37.

HRDLIČKA, ALEŠ 1911 [Measurements of three Fuegian skulls.] In "Los indígenas de la Tierra del Fuego", by Roberto Dabbene. Bol. Inst. Geogr. Arg., vol. 25, nos. 7–8, pp. 283–287.

——— 1926 The Indians of Panama; their physical relation to the Mayas. Am. J. Phys. Anthrop., vol. 9, pp. 1–15.

——— 1940 Catalog of human crania in the United States National Museum collections. Indians of the Gulf States. Proc. U. S. Nat. Mus., vol. 87, pp. 315–464.

——— 1942 Crania of Siberia. Am. J. Phys. Anthrop., vol. 29, pp. 435–481.

HULTKRANTZ, J. VILH. 1898 Några bidrag till Sydamerikas fysiska antropologi. Ymer, Stockholm, vol. 18, pp. 31–48.

Hyades, Paul Daniel Jules, and Joseph Deniker 1891 Mission scientifique du cap Horn, vol. 7 (Anthropologie, Ethnographie), Paris.

Imbelloni, José 1923 Habitantes neolíticos del Lago Buenos Aires: documentos para la antropología física de la Patagonia austral. Rev. Mus. La Plata, vol. 27, pp. 85–160.

Jijón y Caamaño, J. 1912 Contribución al conocimiento de los aborígenes de la Provincia de Imbabura en la Republica del Ecuador. Estudios de Prehistoria Americana, II, Madrid, 345 pp.

de Lacerda, J. B. 1885 O homem dos sambaquis. Contribuição para a anthropologia Brazileria. Arch. Mus. Nac. Rio de Janeiro, vol. 6, pp. 175–203.

Lacerda Filho e Rodrigues Peixoto 1876 Contribuições para o estudo anthropologico das raças indigenas do Brazil. Arch. Mus. Nac. Rio de Janeiro, vol. 1, pp. 47–75.

Latcham, R. E. 1904 a Notes on some ancient Chilian skulls, and other remains. J. Roy. Anthrop. Inst. Gr. Brit. and Ire., vol. 34, pp. 234–256.

——— 1904 b Notes on the physical characteristics of the Araucanos. J. Roy. Anthrop. Inst. Gr. Brit. and Ire., vol. 34, pp. 170–180.

MacCurdy, George Grant 1923 Human skeletal remains from the highlands of Peru. Am. J. Phys. Anthrop., vol. 6, pp. 217–329.

Mantegazza, Paola, and Ettore Regalia 1886 Studio sopra una serie di crani di Fuegini. Arch. Antrop. e Etnol., vol. 16, fasc. 3, pp. 463–515.

Marcano, G. 1890 a Ethnographie précolombienne du Venezuela; Indens Piaroas et Guahibos. Bull. Soc. Anthrop. Paris, 4th ser., vol. 1, pp. 857–865.

——— 1890 b Same; Indens Goajires. Bull. Soc. Anthrop. Paris, 4th ser., vol. 1, pp. 883–895.

——— 1891 Same; Note sur les Cuicas et les Timotes. Bull. Soc. Anthrop. Paris, 4th ser., vol. 2, 238–254.

——— 1893 a Same; Vallées d'Aragua et de Caracas. Mém. Soc. Anthrop. Paris, 2nd ser., vol. 4, pp. 1–86.

——— 1893 b Same; Région des Raudals de l'Orénoque. Mém. Soc. Anthrop. Paris, 2nd ser., vol. 4, pp. 99–218.

Marelli, Carlos A. 1913 Contribución á la craneología de las primitivas poblaciones de la Patagonia. An. Mus. Nac. Hist. Nat. Buenos Aires, tomo 26, pp. 31–91.

Mehnert, Ernst 1893 Catalog der anthropologischen Sammlung des Anatomischen Instituts der Universität Strassburg I. E. Anthrop. Samml. Deutsch., pt. 15, 95 pp.

Neumann, Georg 1942 The origin of the prairid physical type of American Indian. Papers Mich. Acad. Sci., Arts, Letters, vol. 27, pp. 539–542.

Newman, Marshall T. 1943 A metric study of undeformed Indian crania from Peru. Am. J. Phys. Anthrop., n.s., vol. 1, pp. 21–45.

Pöch, Hella 1938 Beiträg zur Kenntnis von den fossilen menschlichen Funden von Lagoa Santa (Brasilien) und Fontezuelas (Argentinien). Mitt. Anthrop. Gesell. Wien, Bd. 68, Heft 3–4, pp. 310–335.

Rey, Philippe-Marius 1880 Étude anthropologique sur les Botocudos. Thèse de Paris, 85 pp.

RIVET, P. 1908 La race de Lagoa Santa chez les populations précolombiennes de l'Equateur. Bull. et Mém. Soc. Anthrop. Paris, 5th ser., vol. 9, fasc. 2, pp. 209–271.

RODRIGUES PEIXOTO, J. 1885 Novos estudos craniologicos sobre os Botocudos. Arch. Mus. Nac. Rio de Janeiro, vol. 6, pp. 205–256.

SCHAAFFHAUSEN, H. 1877 Die anthropologische Sammlung des Anatomischen Museums der Universität Bonn. Anthrop. Samml. Deutsch., pt. 1, 68 pp.

——— 1879–1880 Die anthropologische Sammlung des Museums der Senckenbergischen Naturforschenden Gesellschaft und des Senckenbergischen Anatomischen Instituts, Frankfurt A. M. Anthrop. Samml. Deutsch., pt. 6, 15 pp.

SERA, G. L. 1912–1913 L'altezza del cranio in America; induzioni antropologiche ed antropogeografiche. Arch. Antrop. e Etnol., vol. 42, pp. 64–124; 161–251; 297–329 (South and Central America); vol. 43, pp. 13–88 (Central and North America).

SERGI, GIUSEPPE 1891 Crani Africani e crani Americani. Considerazioni generali craniologiche e antropologiche. Arch. Antrop. e Etnol., vol. 21, pp. 215–268.

SPENGEL, J. W. 1874 Die von Blumenbach gegründete anthropologische Sammlung der Universität Göttingen. Anthrop. Samml. Deutsch., pt. 2, 93 pp.

STEGGERDA, MORRIS 1932 Statures of North American Indians. Eugenical News, vol. 17, pp. 1–5.

——— 1943 Stature of South American Indians. Am. J. Phys. Anthrop., n. s., vol. 1, pp. 5–20.

STEWART, T. D. 1940 Some historical implications of physical anthropology in North America. Smithsonian Misc. Coll., vol. 100, pp. 15–50.

——— 1942 Anthropometric nomenclature. II. The indices of head height. Am. J. Phys. Anthrop., vol. 29, pp. 23–39.

——— 1943 Skeletal remains with cultural associations from the Chicama, Moche, and Virú valleys, Peru. Proc. U. S. Nat. Mus., vol. 93, pp. 153–185.

SULLIVAN, LOUIS R., AND MILO HELLMAN 1925 The Punin calvarium. Anthrop. Papers Am. Mus. Nat. Hist., vol. 23, pt. 7, pp. 313–324.

TEN KATE, HERMAN 1892 Contribution à la craniologie des Araucans Argentins. Rev. Mus. La Plata, vol. 4, pp. 209–220.

——— 1904 Matériaux pour servir à l'anthropologie des Indiens de la Republique Argentine. Rev. Mus. La Plata, vol. 12, pp. 31–57.

TORRES, LUIS MARÍA 1911 Los primitivos habitantes del delta del Paraná. Univ. Nac. La Plata, Biblioteca Centenaria, vol. 4, 616 pp.

TURNER, WILLIAM 1884 Report on the human crania and other bones of the skeletons collected during the voyage of H.M.S. Challenger, in the years 1873–1876. Challenger Reports, vol. 10 (Zoology), pt. 29, 130 pp.

VERNEAU, R., AND H. DE LA VAULX 1902 Les anciens habitants des rives du Colhué Huapi (Patagonie). Congr. Intern. Amer., XII Session (Paris, 1900), pp. 115–140.

Virchow, Rudolf 1872 [Schädel aus den Muschelbergen von Dona Francisca (Brasilien)]. Verhandl. Ber. Gesell. f. Anthrop., pp. 189–191.

———— 1874 a Ein Schädel und ein Steinbeil aus einem Muschelberge der Insel San Amaro [Santos, Brasilien]. Verhandl. Ber. Gesell. f. Anthrop. Ethnol. u. Urgesch., pp. 5–8.

———— 1874 b Schädel von Araucanos und andern Südamerikanern. Verhandl. Berl. Gesell. f. Anthrop. Ethnol. u. Urgesch., Sitzung vom 12, Dec., pp. 7–12 (258–263).

———— 1886 Ein Skelet und Schädel von Goajiros. Verhandl. Ber. Gesell. f. Anthrop. Ethnol. u. Urgesch., pp. 692–706.

———— 1894 Schädel aus Süd-America, insbesondere aus Argentinien und Bolivien. Verhandl. Berl. Gesell. f. Anthrop., Ethnol. u. Urgesch., vol. 26, pp. 386–410.

Walter, H. V., A. Cathoud, and Anibal Mattos 1937 The Confins man — a contribution to the study of early man in South America. Early Man, pp. 341–348, J. B. Lippincott Co., Philadelphia.

Wieger, G. 1884 Die anthropologische Sammlung des Anatomischen Instituts der Universität Breslau. Anthrop. Samml. Deutsch., pt. 12, 45 pp.

Zimmerman, Günter 1935 Über einige interessante Schädel aus Südamerica. Mitt. Anthrop. Gesell. Wien, vol. 65, no. 3–4, pp. 194–203.

THE INCLINATION OF THE SADDLE SURFACE OF THE TRAPEZIUM WITH RESPECT TO THE ANGLE BETWEEN THE THUMB AND WRIST

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TWO FIGURES

Joseph Hyrtl (1889, p. 401), discussing the importance of the thumb, refers to an incident in the Gallic Wars revealing Caesar's order to cut off the thumbs of the enemy captured in Uxellodunum for, it is stated, he would have no fear of them so mutilated as warriors; and in the Peloponnesian War the same practice is cited, carried out by the Athenians upon the oarsmen of hostile galleys, before these prisoners were sent home. Such bits of evidence of knowledge of the value of the thumb in periods of ancient history invite one to speculate as to when the significance of the first digit began to be realized.

Some of the special characteristics of digit I are there in the lowest Primates. Small as is the thumb in old world monkeys and apes, it is an opposable digit. Among new world monkeys there are some species with the thumb rudimentary and other species having no apparent thumb, suggesting that in these arboreal animals the first finger is not very important for climbing. Did the thumb accelerate its progress toward the perfection of its present day pattern when man's ancestors became terrestrial dwellers? In the

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use of rude weapons, stones, clubs, man's attention must have been drawn to that finger which made the hand a grasping organ. He experienced the serious disadvantages resulting from the crippling or loss of this member and must have been deeply impressed over it. The hand, during the operation of most of its functions is within the range of one's vision, and who can doubt that the wonderful adaptability of this organ and particularly of that remarkable finger called thumb, to helpful and vital uses among the things about him, stirred the mind of man at a remote period in his existence.

The thumb enjoys greater freedom of movement than do the other fingers. This follows chiefly from the mobility of its carpo-metacarpal articulation, contrasting in this respect with the extremely limited movement permitted at the carpo-metacarpal joints of the other fingers. Greater freedom of movement of the thumb is provided also through the volarward projection of its carpo-metacarpal joint beyond the frontal plane of the remaining carpo-metacarpal articulations. There is thus provided freedom of movement of the first digital ray across the rest of the metacarpus. Yet another conspicuous feature of the hand skeleton adds greatly to the thumb's mobility: this is the wide divergence radially and distally of metacarpal I from its articulation with the carpus, resulting in setting off the thumb, when abducted, from the rest of the hand, at an angle of about 135 degrees with the radial side of the wrist.

The thumb swings freely at its carpo-metacarpal joint, the other fingers bend on the palm at their metacarpo-phalangeal joints, and their standing in the same plane and close together, limits their range of movement. They present their pulps volarwards and cannot rotate excepting by passive motion, and then but slightly. The thumb, however, can present its pulp distally, dorsally and ulnarward to oppose the other fingers. It is apparent that the thumb is not merely another finger repeating the functions of the four ulnar digits, but one set apart and of a special pattern adapted to perform actions of a different sort, bringing about combina-

tions for additional uses of the hand. It is not an auxiliary in the sense of helping the other fingers in their particular forms of movement.

Of the skeletal features above referred to that seem to be correlated with the free range of movement of the thumb, that chosen for study as the least involved with other factors and one that might be expected to yield interesting data, is the divergence of the thumb metacarpal from the habit of the rest of the metacarpal series; the question of the projection of the thumb away from the rest of the hand. This divergence is coupled with the position of the trapezium in the carpus and with the oblique direction or inclination of the proximo-distal axis of the saddle surface of the latter with which the first metacarpal articulates. With regard to the position of the trapezium in the carpus, the significant relation that concerns the divergence of the thumb is the plane of its articulation with the trapezoid: whether this plane is inclined so as to influence the degree of divergence. This possible factor was not included in the present study. There remained, therefore, the investigation of the degree of inclination of the proximo-distal axis of the saddle surface of the trapezium. It was believed that the degree of inclination of this axis would serve as a criterion for comparisons that would be undertaken.

The most reliable method for finding the amount of inclination of the saddle surface seemed, after many trials, to be that of measuring the angle made by the proximo-distal axis of the saddle surface and the proximo-distal axis of the trapezoid facet of the trapezium (fig. 1). This angle, for convenience will be called the "trapezial angle" or "angle of the trapezium" throughout the paper.

In order to measure the trapezial angle special apparatus was devised. It consists of a metal protractor mounted on a baseboard to which a hard wood strip is fastened, one edge being applied exactly to the line 0 degree to 180 degrees (fig. 2). The hollow space of the protractor is filled by cardboard to the thickness of the metal of the instrument and glued to the baseboard. The strip is 12 mm. thick, somewhat

more than the volar-dorsal diameter of the largest trapezium measured. An oblong bronze rod 8 cm. long and 15 mm. in cross diameter completes the apparatus.

To measure the angle, the trapezium is placed on its dorsal surface on the cardboard filling of the protractor, the margins of the saddle surface touching the hardwood strip, the distal end of the bone toward the center of the arc of the protractor. The bronze rod is then made to rest on the baseboard, one end at the center of the protractor and one surface touching

Fig. 1 X-ray of the right hand of a Negro male, age 38 years. The angle of the trapezium is indicated.

the trapezoid articular surface of the trapezium: the angle is read upon the protractor.

The proper posing of the bone is essential to accuracy. When the trapezium rests on its dorsal surface on the board, the articular facet for the trapezoid is approximately at right angles with the board. The very few bones that were so distorted as to show a decided slant of the trapezoid facet were discarded. It should be emphasized that the facet in

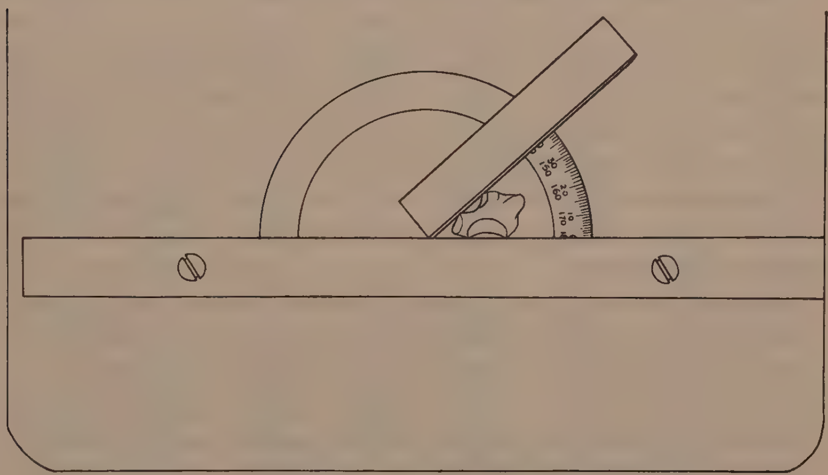

Fig. 2 Apparatus for measuring the trapezial angle.

question will be at right angles to the baseboard or nearly so in a normal trapezium placed on its dorsal surface. Some bones refused to rest on the dorsal surface and would fall to one or the other side. After many trials to obtain the same measurement consistently by holding such bones with the trapezoid facet vertical, and failing to do so, these bones (there were five in the whole number inspected) were rejected. The trapezium must not be held in position against the strip, nor must it be allowed to support itself by rocking toward and so resting upon the strip. Only by the gentlest handling should the bone be made to rest naturally on its dorsal surface with the margins of the saddle surface touching the

strip; and it is best to have it removed some distance toward the perimeter of the protractor.

One further detail of importance must be mentioned, namely the lighting. In order to make sure that the trapezium is upright upon its dorsal surface and the two articular surfaces concerned are in contact with the strip and the rod respectively, a strong overhead light is essential and the baseboard carrying the protractor must be freely movable, permitting shifting of the whole apparatus to avoid shadows. Only when all the points of contact can be verified should the measure be read on the protractor. The apparatus and method here described were devised after much experimental orienting, particularly in learning that the natural posture of the bone must not be disturbed by efforts to hold it in place. Checking my measurements by repeating them on bones taken at random has given me confidence in the reliability of the method when carefully employed.

Material for this study was afforded by the Washington University Skeletal Collection in numbers sufficient as samples for investigation of possible side and sex characters, but limited to only two stocks, namely American Negroes and American Whites, for search after possible racial features. Hands were selected from skeletons whose ages ran from 30 to 50 years inclusive, with the purpose of having only mature bones and of excluding older bones deformed by age changes about the articular surfaces. An exception to the age range had to be made in the case of white females, whose number in the collection is relatively small and the age of the large majority fifty and above. In this group only trapezia free of lipping that would affect the measurement, were chosen.

There were pairs of hand skeletons from 379 cadavers used in the investigation, of which 100 were from Negro males, 100 from Negro females, 100 from White males and 79 from White females; a total of 758 trapezia. As to the nativity of the subjects, our present incomplete record shows that all the Negroes with one exception (a woman born in Canada) were born in the United States, the larger number by far in

TABLE 1

Measurements of trapezial angle: White males.

NUMBER	AGE	DEGREE OF ANGLE		NUMBER	AGE	DEGREE OF ANGLE	
		Right	Left			Right	Left
29	40	42	47	513	50	49	52
45R	45	45	42	517	45	48	48
47	45	44	49	525	50	49	48
81	45	45	48	546	40	55	62
109	50	37	43	557	50	35	38
110	50	37	38	564	45	46	53
131R	48	54	56	566	40	45	47
133	50	37	42	575	45	50	50
135	35	48	50	577	50	37	39
163	50	48	49	591	28	48	48
180	45	40	43	596	50	43	43
181	40	46	47	599	45	38	42
184R	42	41	48	602	50	44	50
195	40	53	54	641	55	52	50
196	35	38	33	696	30	49	54
206	50	42	47	709	48	45	44
207	45	43	43	739	43	42	44
216	45	42	43	747	50	41	40
221	45	45	44	751	45	54	53
229	45	52	49	755	33	42	39
230	40	45	51	756	48	36	42
233	42	47	49	763	44	41	40
237	35	50	37	787	50	47	45
241	45	32	46	839	47	44	47
250	50	47	50	846	48	40	48
260	50	44	51	867	35	45	41
267	40	50	45	872	48	52	55
273	50	51	55	895	50	41	35
279	30	51	44	946	48	48	56
315	50	43	43	989	30	52	50
318	45	49	42	1037	50	47	47
320	45	43	46	1043	45	49	52
332	45	52	50	1079	40	42	42
342	40	47	51	1089	40	44	42
343	40	41	45	1126	40	45	50
362	30	27	34	1167	53	49	49
365	50	50	50	1193	51	40	43
380	45	52	56	1221	51	48	51
393	40	51	49	1242	50	42	43
411	50	38	41	1250	50	47	51
414	35	47	48	1255	35	28	28
415	45	44	48	1286R	50	51	47
429	50	44	44	1324	50	42	51
431	40	48	45	1442	45	45	44
434	40	47	50	1458	37	47	55
440	50	46	49	1499	47	48	50
448	45	51	51	1520	52	44	38
453	40	38	37	1534	44	59	55
463	50	50	52	1546	52	50	53
506	45	51	51	1550	39	49	56

TABLE 2

Measurements of trapezial angle: White females.

NUMBER	AGE	DEGREE OF ANGLE		NUMBER	AGE	DEGREE OF ANGLE	
		Right	Left			Right	Left
12R		48	50	967	53	49	42
20R	78	51	52	983	30	50	47
28	71	49	42	992	64	58	57
37R	55	36	40	997	88	54	56
43	80	47	50	1016R	54	47	46
53R	60	56	57	1069	70	46	47
64R	57	47	50	1085R	71	46	47
108R	70	49	51	1103	74	43	40
218	56	50	54	1109R	69	39	44
228	68	55	53	1119	63	52	53
240R	63	48	56	1120	24	49	46
275	47	52	52	1137R	78	50	57
321	61	45	42	1139	76	55	56
327	73	53	50	1153	30	38	38
373	55	44	43	1155	64	54	52
451	72	48	48	1174	53	51	55
464	64	44	49	1186	44	45	38
480	75	34	40	1199	45	51	53
481	67	54	57	1212	87	51	61
482	54	45	53	1233R	63	47	50
512	50	51	52	1296R	52	44	55
544	75	57	59	1353R	50	35	43
580	61	47	50	1370	80	52	49
601	75	45	50	1405	67	40	54
611	65	51	50	1432	84	40	50
639	82	40	44	1433R	78	50	55
680	40	41	48	1456	60	49	42
736	57	45	46	1473R	74	52	58
781	60	51	48	1476	51	47	49
791	66	54	53	1480	64	43	44
834R	87	53	56	1482R	35	51	43
837R	86	51	49	1491R	75	43	53
847	39	52	52	1512	37	52	51
869	59	56	56	1517	76	44	52
880	27	44	45	1523	36	40	41
899R	65	45	47	1528	73	49	47
904R	52	49	47	1542	67	48	50
925	71	49	55	1556	80	56	53
934	62	56	55	1558	52	51	48
				1559	91	50	52

TABLE 3

Measurements of trapezial angle: Negro males.

NUMBER	AGE	DEGREE OF ANGLE		NUMBER	AGE	DEGREE OF ANGLE	
		Right	Left			Right	Left
4R	40	34	35	475	41	39	40
17	31	49	50	483	44	38	43
54	46	42	42	486	46	46	44
70R	42	42	46	490	36	30	34
77	40	47	45	492	31	45	43
84	30	39	40	494	37	47	48
87	53	45	45	504	40	45	50
100	33	40	37	518	41	43	42
101	32	37	36	522	30	33	37
112	36	43	40	523	47	46	42
117	50	53	52	524	50	43	44
120	44	44	42	537	48	49	50
138	49	51	50	540	40	34	41
145R	31	50	48	549	33	37	37
153R	34	47	46	551	40	41	42
182	43	47	44	565	32	37	35
193	47	37	38	570	37	48	49
209	38	39	43	571	31	47	48
213	31	43	47	574	35	35	33
226	47	43	40	578	32	44	43
235	30	43	46	581	30	42	41
248	47	50	52	582	49	47	48
251	33	38	39	619	31	40	38
265	32	41	41	631	43	50	52
269	30	39	39	646	50	37	40
291	45	44	43	656	43	38	39
292	49	50	45	658	42	38	45
308	35	42	42	659	30	34	31
309	44	47	42	663	44	49	51
310	43	45	45	664	48	37	40
322	48	49	46	673	38	41	39
336	48	47	41	676	46	41	46
349	50	38	46	684	35	40	42
351	42	39	39	702R	47	39	40
353	37	44	42	704	40	36	36
360	46	37	45	705	46	43	49
391	50	33	38	712	47	45	39
398	32	50	46	727	45	41	43
400	44	39	41	737R	38	45	47
401	43	47	46	771	49	39	39
402	50	51	51	776	40	39	42
404	37	38	37	777	42	45	45
441	50	41	41	779R	39	43	43
443	46	45	42	782	30	41	39
447	49	38	43	789	40	44	47
458	41	46	48	792R	31	34	40
462	42	53	52	793	42	33	33
466	31	32	34	798	36	47	40
471	38	33	34	799	38	43	44
474	43	40	42	807	36	40	44

TABLE 4

Measurements of trapezial angle: Negro females.

NUMBER	AGE	DEGREE OF ANGLE		NUMBER	AGE	DEGREE OF ANGLE	
		Right	Left			Right	Left
23R	49	45	45	900R	42	50	55
51R	47	54	54	907	41	41	50
60R	39	51	51	920	36	52	49
95	35	45	38	921	38	36	40
114	43	48	47	927	35	37	38
123	43	40	37	948	39	51	45
132R	39	40	40	952	41	51	51
139	35	46	45	959	46	43	47
146R	30	45	51	978	46	41	42
151R	50	54	55	985R	49	44	41
171	29	49	43	994	30	51	51
177R	33	49	55	995	38	44	43
208	30	44	51	996	31	47	47
272	49	43	54	1015	41	37	46
280	24	41	46	1027	41	44	46
286	50	42	45	1034	48	43	44
294	33	45	43	1042R	39	44	49
330	38	52	52	1064	33	47	47
341	38	42	40	1083	40	50	46
348	28	45	54	1096	48	40	39
472	35	43	45	1127	46	43	45
487	42	51	45	1129	50	44	44
488	40	43	40	1150	39	43	46
511	34	49	49	1163	41	56	58
529	37	44	43	1173	38	50	44
541	28	49	48	1182R	48	46	48
568	27	45	47	1198	42	48	49
584	40	48	50	1210	46	47	47
588	40	43	50	1222	29	56	51
603	50	43	43	1236	36	43	44
610	39	44	41	1244	38	46	47
615	35	42	47	1249R	40	40	42
625R	39	44	44	1252	50	52	46
627R	27	38	42	1258R	50	38	43
655	39	47	50	1306	36	44	45
657R	28	45	44	1332	45	40	43
679	33	50	53	1333	33	42	45
699	43	44	43	1347R	38	44	40
706	38	37	40	1348R	49	37	41
738	43	44	47	1356	35	46	48
766	35	43	45	1393	41	50	51
774R	33	47	51	1396	28	47	46
815	32	45	47	1401	47	50	50
824	30	38	39	1402	31	48	48
831	44	43	39	1417R	37	48	54
840	32	49	48	1421	50	47	46
844	26	46	46	1464	45	43	41
873R	48	43	44	1510	50	46	43
887	34	35	36	1538	39	47	53
891	39	50	48	1555	41	41	41

the states south of the Ohio and Missouri rivers. Whereas the Whites, whose birthplaces are recorded, are nearly all Americans of native parentage, there is in the group a small number of native born with one or both parents born in Europe, and also a small number of native Europeans. Our records of the occupations of the persons in the present group have some gaps which are being filled. Because of the incompleteness of the data on nativity and occupation, consideration of these aspects must for the present be deferred.

The results of the measurements and of their statistical treatment are shown in tables 1 to 4 and the Summary following.

Measurements of trapezial angle: Summary.

ITEM	NO.	RANGE	MEAN	S.D.	C.V.
White male. Right	100	27–59	45.28 ± .56	5.58 ± .39	12.31 ± .87
White male. Left	100	28–62	46.74 ± .58	5.78 ± .41	12.37 ± .87
White female. Right	79	34–58	48.16 ± .59	5.26 ± .42	10.92 ± .87
White female. Left	79	38–61	49.62 ± .61	5.44 ± .43	10.96 ± .87
Negro male. Right	100	30–53	42.22 ± .52	5.24 ± .36	12.40 ± .86
Negro male. Left	100	31–52	42.58 ± .49	4.72 ± .34	11.02 ± .80
Negro female. Right	100	35–56	45.12 ± .44	4.40 ± .31	9.75 ± .69
Negro female. Left	100	36–56	46.11 ± .46	4.62 ± .33	10.01 ± .71
All Whites	358	27–62	47.28 ± .20	5.76 ± .22	12.18 ± .46
All Negroes	400	30–56	44.19 ± .20	5.02 ± .18	11.31 ± .27
All males	400	27–62	44.39 ± .28	5.60 ± .20	12.61 ± .45
All females	358	34–61	47.06 ± .27	5.20 ± .19	11.05 ± .41
All rights	379	27–59	45.12 ± .28	5.48 ±. 20	12.14 ± .44
All lefts	379	28–62	46.18 ± .29	5.62 ± .20	12.14 ± .44

The measurements by groups are given in the Summary. Comparing the samples of all Negroes and all Whites, it is seen that the range of the size of the trapezial angle is smaller in the former. A significant difference in the means was found, Negroes having a smaller angle than have Whites. Negroes appear to be 92.86% as variable as Whites with regard to the angle.

Concerning sex, the range of measure of the angle seems to be less in all females than in all males; the mean of the angle is significantly greater in females; the latter are 87.63% as variable as males, respecting the trapezial angle. Since the age of the White females averages higher than that

of other groups the possibility of senile changes affecting the measurements must be considered.

As to the comparison of right and left bones: the ranges of the angles are nearly the same; the mean of the angle for left trapezia is a degree greater than that for the right (calculating by probable error of means, 3.85 times the difference); the variability the same for the two sides.

If the statistical treatment is without fault, then it will be observed that the angle of the trapezium is more acute in all Negroes than in all Whites, in all males than in all females and that no significant difference was found between all rights and all lefts. Referring to the summary, it will be found that in all groups the angle of the left is greater than the angle of the right trapezium. Calculating the difference by the probable error of the means indicates a near approach to significance. Now, in our whole collection there is but one recorded instance of left handedness and unfortunately, that one so old an individual that the trapezial angle could not be accurately measured because of lipping of the articular margins. I have no data on the trapezial angle in persons left handed. It is a fair assumption that in the present series of 379 individuals there was the usual proportion (whatever it is) of cases of left handedness. If in these cases the left angle is the smaller, the reverse of what the above figures show, then the presence of trapezia of left handed individuals would tend to lessen the amount of the difference between the right and left angles in the whole series and would thus falsify the true ratio between right and left bones of right handed people. I believe that when the trapezial angle of left handed persons is measured in a sufficient number the figures for right and left will be the reverse of what obtains in the right handed. That is to say that in a collection of known right handed skeletons, a significant difference in the trapezial angles of the right and left sides would be found, the right more acute than the left angle.

The size of the trapezial angle must have its influence on the position of the first metacarpal bone and specially on the degree of its divergence from the second metacarpal;

and this influence would extend to the whole first ray embodied in the thumb. The amount of influence exerted by the trapezial angle would be modified by other factors, notably the position of the plane of the trapezium-trapezoid articulation. Leaving other influences out of consideration and dealing only with the trapezial angle, it seems clear that the smaller the angle, the more radialward the saddle surface would look, the farther removed would the first metacarpal be from the second metacarpal, the smaller the angle between the thumb and the wrist. The differences in size of the trapezial angle between the groups examined, even if not erased by other factors operating upon the divergence of the first metacarpal, could hardly be expected to show, by casual inspection, their influence upon the angle of the thumb and wrist in the living. Nevertheless, if the several series of measurements taken on the samples presented here are accurate, and the statistical deductions true, a constant feature shown in the mean of the trapezial angle, characteristic of each of the groups is resident in the meeting place of thumb and wrist.

SUMMARY

One aspect of the position of the human thumb was investigated, namely its wide separation from the other fingers, presenting when abducted an angle with the wrist. The direction of the axis of the saddle surface of the trapezium influences the divergence of the first metacarpal away from the positions held by other metacarpals, and so the angle made by this axis with the axis of the trapezoid articular surface of the trapezium (called the trapezial angle) was taken as the criterion for comparing the divergence of the thumb in respect to sex, side and race. The mean of the angles of all Negroes was $44.19 \pm .20$, of all Whites $47.28 \pm .20$, of all males $44.39 \pm .28$, all females $47.06 \pm .27$, all rights $45.12 \pm .28$, all lefts $46.18 \pm .29$. The differences were statistically significant excepting for right and left sides.

LITERATURE CITED

Hyrtl, Joseph 1889 Lehrbuch der Anatomie des Menschen. Zwanzigste Auflage. Wien.

AN EXPERIMENT BEARING ON THE PROBLEMS OF PHYSICAL ANTHROPOLOGY

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FIVE FIGURES

Physical anthropology is a descriptive science concerned with the evolution of mankind and with the variation among the groups of living men. Schultz ('30) states that, "Physical anthropology can thus be regarded as the science of describing, classifying, and explaining man's variations." If we examine what anthropologists do, we find that describing and classifying are the major activities. It is for this reason that discussions of method in physical anthropology are confined largely to the technique of measurement and to methods of analysis. The anthropologist operates on the assumption that his problems can be solved if the description is accurate and the analysis flawless. However, it is doubtful that even perfection in description will necessarily lead to correct explanations.

If explanatory theories could be proved by purely descriptive data, we might expect that the classic anthropological problems would now be solved, or at least be much nearer solution than they were half a century ago. Surprisingly enough, this appears not to be the case.

An example of a problem which has been the subject of debate for over 80 years is the question of what factors determine the form of the braincase. Is the shape of the braincase due to the brain, to the muscles of mastication, or to both of these and still other factors? Numerous papers

have championed every possible point of view, and the whole controversy has been reviewed recently by Weidenreich ('41). Here we are not concerned with this problem, except to point out that there is still no agreement. The views of Hrdlička and Weidenreich are as far apart today as were those of Virchow and Fick in 1859.

There are abundant descriptive data concerning every phase of this problem. The conditions in different races, in fossil men, in microcephals and hydrocephals, in apes, monkeys, and many other animals have all been described. Many famous anatomists and anthropologists have contributed to the understanding of the problem. Yet a solution which demands acceptance has not been forthcoming. Considering the data available, the ability of the investigators, and the length of time over which the controversy has extended, we have a right to wonder whether this problem can be solved by comparative methods alone.

There are other situations in which comparative methods have proved equally inconclusive, and these problems have certain features in common. Whenever one explanatory theory is the exact opposite of its rival, it is extremely difficult to resolve the conflict by comparative methods. For example, are long lower extremities the result of bipedal locomotion or is bipedal locomotion the result of the long lower extremities? Logic works equally well either way, and we become involved in a vicious circle. Another situation in which simple comparison is inconclusive occurs when there are two or more equally reasonable theories which seem to explain the available facts.

If there is some truth in several points of view, it is difficult to decide the relative merits of each by description alone. What if the shape of the braincase is due in part to the brain, in part to the base of the skull, and in part to the muscles of mastication? How are the relative roles of a number of interacting factors to be elucidated in a comparative study?

Even with abundant descriptive data which no one questions, explanation and interpretation still cause difficulties. Many controversies will not be solved by the addition of more and more data because of the logical dilemmas outlined above. Other sciences have been in similar situations, and anthropology can profit by the experience of others. The position of anatomy was much like that of physical anthropology as long as anatomists relied on purely descriptive techniques. Although abundant data had been compiled, there still remained a number of problems upon which the most competent anatomists could not agree.

Detwiler ('29) described some of the changes in anatomy which followed the development and use of experimental methods to supplement purely descriptive ones. The mode of origin of the nerve fiber had been debated for 75 years. "The ablest anatomists of Europe" failed to prove whether the nerve fiber grew from one cell or was the product of many cells. The problem of origin of the nerve fiber occupied a central position in anatomical thought, much as the shape of the braincase has in anthropological thought. A vast amount of descriptive data was accumulated, but still the rival theories continued. It was not until Harrison invented tissue culture, and the nerve fiber could be seen growing out from the cell, that the controversy was finally settled. One series of experiments proved conclusively which theory was correct.

For more than a century anatomists have regarded the segmentation of the nervous system as a primary vertebrate character. The homologies of the muscles have been traced by the nerves, and the establishment of the nerve-muscle relationship was regarded as the final proof of homology. Detwiler ('34) experimenting upon the spinal cord of Amblystoma embryos reached the conclusion that normal segmentation of this structure is dependent on mesodermal segmentation. If brachial somites are removed without injuring the nervous system in any way, the number of nerves is reduced. If the number of segments is increased by the intercalation of additional somites the number of nerves is increased. The

position and number of nerves entering the limb correspond to the position and extent of the limb bud in the embryo (Miller and Detwiler, '36). The limb functions normally if any one of the nerves which ordinarily form the brachial plexus enter the limb (Detwiler and Carpenter, '29).

These experiments show that the relation between the muscles and nerves is quite different from that which was postulated on the basis of comparative anatomy alone. Normal segmentation in the nervous system is dependent on the mesodermal somites and normal function of a limb is not dependent on a normal nerve supply. The relation of the nerves to a limb presents a problem which is logically of the "vicious circle" type. Segmentation of the nerves may be due to inherent factors, to the mesoderm, or to both. In comparative studies, no matter how thorough the description and delicate the technique, a correlation of nervous and mesodermal segmentation is always observed. The relative importance of these can not be ascertained unless the normal course of development is radically changed by experimental means.

These experiments were a natural result of an anatomical problem. If description had sufficed to determine the relative roles of nervous and mesodermal tissue, there would have been no need for extensive experimental investigations. The problem originated in descriptive anatomy, but explanation was impossible until experimental work had been done. Experiments were used as the only method of interpreting a correlation which could not be resolved by description or logic.

When description and logic fail to provide an indisputable explanation, anthropologists should avail themselves of experimental methods. It seems difficult for anthropologists to do this, or even to use the experiments of others, because anthropology is traditionally viewed, not only as a comparative field, but also as one restricted to the primates and especially to man. Definitions of the field imply a limitation of the animals studied as well as methods used. Man can not be used as a subject of experimentation, and other primates are

expensive and difficult to maintain, but experimental work can be done on small, inexpensive animals which grow rapidly.

The use of the common laboratory animals to elucidate anthropological problems should not be as difficult as it may appear at first sight. This is because the problems of interpretation, which purely descriptive work will not solve, are of a general nature. Nerve-muscle relationships, the effects of environment or altered function, the mechanics of growth or similar problems are not new, nor are they restricted to the primates. Man is a mammal, and it would be strange indeed if the laws which govern the human body were different from those which control other mammals. If there is any truth in the classificatory system which anthropologists have labored to evolve, experiments on man's relatives should aid in understanding human problems.

To require that physical anthropology limit itself to the primates is like insisting that medical research cease using laboratory animals. Simply because the results of this research are to be used for man is no reason to insist that all investigations be carried out on human beings.

Anthropology has developed refined methods of measurement and has used efficient methods of analysis, but it has not insisted that explanatory theories be checked. If experiment can demonstrate that some animal actually reacts in the manner a theory demands, surely the theory is more probable than if the theory postulate that man varies in a unique way. Even though man can not be used in experiments, experiment can show that homologous parts of other vertebrates actually behave the way man is supposed to. Thus experiments can show whether anthropological theory is biologically sound.

For example, several studies have shown that the proportions of emigrants may differ from those of sedentes of the same stock. Is it reasonable to suppose that diet has caused such changes? The study of Warkany and Nelson ('41) on rats whose mothers received a deficient diet showed that over 40% of the experimental animals showed gross, multiple

skeletal abnormalities. Hale ('37) has shown that microphthalmia with numerous associated defects (hare lip, cleft palate, displaced kidneys) is produced by lack of maternal vitamin A in pigs. Such experiments show that the effects of diet alone may be far greater than the changes observed in any emigrants. Therefore, changed diet provides a reasonable explanation of the changes observed. However, if it had been shown that the proportions of other mammals could not be altered by dietary deficiencies, then every possible alternative would have to be extensively explored.

On the other hand, Sheldon ('40) supposes that his endomorphic type owes its great fatness to a predominance of the endoderm and its derivatives. According to Rony ('40) who has reviewed a large number of studies on experimental animals as well as much clinical literature, fatness may be due to the glands of internal secretion, the nervous system, diet, or heredity. Clearly there is no simple correlation between quantity of fat and any one causal factor. Even discounting the clinical studies, Sheldon's explanation demands that human morphology obey laws very different from those which govern other mammals. If explanatory theories are to be more than speculation, it should be possible to show that some animal actually does behave in the way the theory demands. The first of the two examples cited above is a case in which the conclusions of comparative studies are greatly strengthened by showing that, under carefully controlled conditions, much greater effects than those demanded by the theory have actually been produced. In the second example, the use of data derived from experiments makes the explanation seem doubtful. In both cases the experimental data are used to test the probability of the explanation only. Thus experiment appears as an aid in the interpretation of descriptive data. Experiments do not replace any of the usual anthropological procedures but serve to check the biological soundness of theory.

If experiments are to be given the critical role of judges over the interpretations given to descriptive data, the ex-

periments must be made to conform to the descriptive situations as nearly as possible. Now, as Hale points out, it is unlikely that any human population would completely lack vitamin A. Therefore, it is possible to dismiss the experiments on the ground that such extreme dietary deficiencies have not been demonstrated in man. The same arguments may be brought against Warkany and Nelson's study. Also the results of these experiments are not described in the way best suited for anthropological use. The experimental animals were infants when sacrificed. The differences between experimentals and controls were not measured and many points of great anthropological interest were not described at all. Likewise the experiments used to test one of Sheldon's explanatory theories obviously are not altogether satisfactory for that purpose. The authors never intended that the experiments should be used to test constitutional theories, and therefore no effort was made to present data in a way suitable for constitutional analysis.

We may conclude that experiments which were made for one purpose are unlikely to have been performed and described in a way which will allow the results to be used for other purposes. Experiments culled from the literature are more likely to be suggestive than definitive. If anthropological theories are to be tested, experiments will have to be designed to fit anthropological situations. This means that some anthropologists will have to cooperate in the experimental work. Experimenters in other fields can not be expected to have particular anthropological problems in mind. Therefore, some anthropologists must take an active part in the necessary experimental work or many of their problems will remain unsolved.

An appeal for a change in traditional ways of thinking and doing carries little weight unless concrete evidence of the usefulness of the point of view is supplied. As an example of the way in which experiments may be used to test the probability of theories, we have chosen the relation of the eyeball to the orbit. In discussing this problem we will try to

show how the inclusion of experimental evidence supplements comparative studies and how we were forced to perform a series of new experiments because those described in the literature omitted the points of greatest anthropological interest.

In a recent study on the "size of the orbit and of the eye in Primates," Schultz ('40 a) concludes, ". . . . that the size of the orbit is not closely determined by the size of the eyeball, but is at best dependent upon it in only a very general way." Weidenreich ('41) attributes this lack of correlation to the different growth rates of eye and orbit. The rate of growth of the human eyeball is closely similar to that of the brain (Todd, Beecher, Williams and Todd, '40). By the third year the eyeball has nearly attained adult size and subsequent growth is extremely slow. The orbit on the other hand, increases much more in post natal life than does the volume of the eyeball (Schultz, '40 a). The effect of the growth of brow ridges and facial skeleton on the orbit is beautifully illustrated in Schultz's studies on the growth of the chimpanzee ('40 b) and the orang-utan ('41).

The effects of this late growth in determining orbital shape have been noted in baboons (Martin, '28) and in langurs and macaques (Washburn, '42). Cameron ('20) attributed some features of the orbit in primitive man to the pull of enlarged muscles of mastication.

However, in spite of the importance of late growth in determining adult orbital capacity and shape, there is some correlation between the size of the eyeball and the orbit. In nocturnal primates with much enlarged eyes (Tarsius, Loris, Nycticebus, Aotus) the orbits are enlarged also. Since very large eyes are associated with large orbits and since there is a much closer correlation between size of eyeball and orbit in the infant and late fetus than in the adult, we might suspect that the relation of eyeball and orbit is much closer in early development than it is in adults or even juveniles. Fortunately, we do not have to be content with suspicions because

some experimental work has been done on the relation of the eyeball to the orbit.

Gudden (1876), Popow (quoted in Lesshaft, 1892), and Wessely ('20) experimented on the relation of eye to orbit in mammals. If the eye of an infant rabbit, dog, or pig was removed, the orbit on the operated side grew less rapidly than that on the unoperated side. Results were especially pronounced in the rabbit. In this animal the slower growth in the region of the orbit causes the snout to deviate toward the operated side.

Wessely ('20) produced rabbit eyes of twice normal volume by injuring the eyes so that a secondary glaucoma developed. The size of the orbit was greatly increased on the operated side. The rabbit is particularly suitable for such experiments because the eye fits closely in the orbit and because the adult eye has fifteen times the volume of the eye of the newborn compared to only three in man.

These experiments show that the correlation between eyeball and orbit in the infant is partially determined by the growing eye itself. The lack of correlation observed in adults, dependent on late growth of the facial skeleton, has been replaced in infants by a close correlation which has been demonstrated in a number of mammals.[1]

However, these structures of infant mammals are well developed. The bones of the orbit are ossified, and the eyeball has completed much of its growth. If the experiments could be performed at a much earlier stage, the results might be far larger. In normal development the interaction of eyeball and orbit must commence as soon as these parts differentiate, long before the period of the above described experiments.

The best experimental data, those of Wessely on rabbits, show the need of both increasing and decreasing the size of the eye. It is only thus that a complete picture of the inter-

[1] However, Chase and Chase ('41) found no differences in the orbit between a strain of anophthalmus mice and those with eyes. Increasing the size of the eyeball seems to produce more uniform effects than decreasing it.

dependence of the eye and orbit may be gained. To increase the size of the eye at a very early stage of development involves great technical difficulties. This has never been accomplished in any mammal. However, a direct experimental investigation at extremely early stages can be made in amphibian embryos by transplanting an eye from the large Amblystoma tigrinum into the much smaller Amblystoma punctatum. It has been shown that the grafted tigrinum eyes grow to nearly the same size as the eye of unoperated, donor controls. Twitty and Elliott ('34) present the most complete analysis of the effects of transplantation on the growth rate of the eye and review the literature on this subject. As the tigrinum eyes are much larger than normal punctatum eyes there must be some accommodation in the structures of the host.

Heteroplastic transplantations of the nasal placodes (Burr, '16, '30), of the ear (Richardson, '32), and of the eye (Twitty, '32) have shown that the development of the nasal, otic, and optic capsules depends on the size of the grafted organ and on the amount of cartilage forming tissue available. If the organ is excised completely, the capsule fails to develop. This is shown in Burr's ('16) reconstruction of the chondrocranium of Amblystoma punctatum from which an olfactory placode had been removed.

The present study is concerned with the extent to which the grafted eye can change the proportions of the chondrocranium. It should be noted that, although there are numerous papers on transplantations of eyes, we could find none in which the changes in the proportions of the orbit were measured. The experiments cited above omit the items which are of particular interest to the anthropologist.

In Amblystoma the olfactory capsule forms the anterior orbital wall and the otic capsule the posterior wall. The optic capsule, enclosing the eye, lies between these two. The rapid growth of the large transplanted eye displaces the surrounding parts, causing marked asymmetries in the experimental animals. The extent of these asymmetries gives a measure of

the effect the eye may exert on surrounding parts during early development.

EXPERIMENTAL

All the operations were performed by S. R. Detwiler. The host embryos were in the early tail-bud stages (Harrison's stage 27, fig. 1).[2] The optic vesicle with the overlying ectoderm was removed from an Amblystoma punctatum embryo and was replaced by the corresponding region from a donor tigrinum embryo. This operation does not disturb the relations of the surrounding parts.

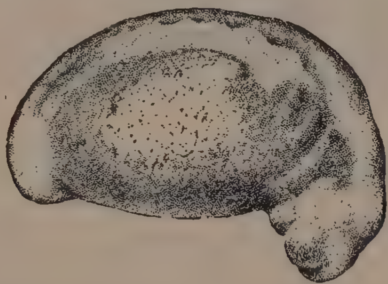

Fig. 1 Drawing of Amblystoma punctatum in stage 27. × 10.

The animals were allowed to grow from 50 to 60 days and were fed maximally. During this period the transplanted eyes grew normally and vision developed just as in the eye on the unoperated side. Figure 2 shows the appearance of the animals at this time. The animals were sacrificed, fixed, and sectioned.

The transplanted eyes might exert pressure anteriorly moving the nasal capsule and posteriorly displacing the otic capsule. To measure to what extent such displacements had actually taken place, the amount of displacement of the opening of the olfactory pit into the mouth and of the point of exit of the seventh and eighth nerves was measured. The results are shown in table 1. On the operated side the nasal

[2] Plates of all of Harrison's stages for Amblystoma punctatum (maculatum) are available in Hamburger ('42).

Fig. 2 Photomicrograph of cases 104 (right) and 118 (left) showing large implanted tigrinum eye on right side. × 4.5.

opening is always displaced anteriorly and the ear region posteriorly.

Much of the variation in the results is due to the fact that the orbital region in Amblystoma is extremely shallow, and the large transplanted eye tends to grow so far laterally that

TABLE 1

Changes in the size of the orbit of Amblystoma punctatum caused by the implantation of an eye from A. tigrinum. Measurements are in millimeters.

CASE NO.	ANTERIOR DISPLACEMENT OF OLFACTORY REGION	POSTERIOR DISPLACEMENT OF OTIC REGION	ORBIT ON OPERATED SIDE IN PER CENT OF NORMAL ORBIT
1	.45	.07	116
8	.24	.07	110
16	.14	.25	112
104	.71	.14	129
115	.73	.45	144
118	.51	.06	120

Degree of asymmetry in the orbit of punctatum controls.
Control 1 2%.
Control 3 4%.

it can extend anteriorly lateral to the olfactory capsule (fig. 3). Maximum results could be obtained only if the transplanted eyes were in a deeper orbit, such as is characteristic of the Anthropoidea.

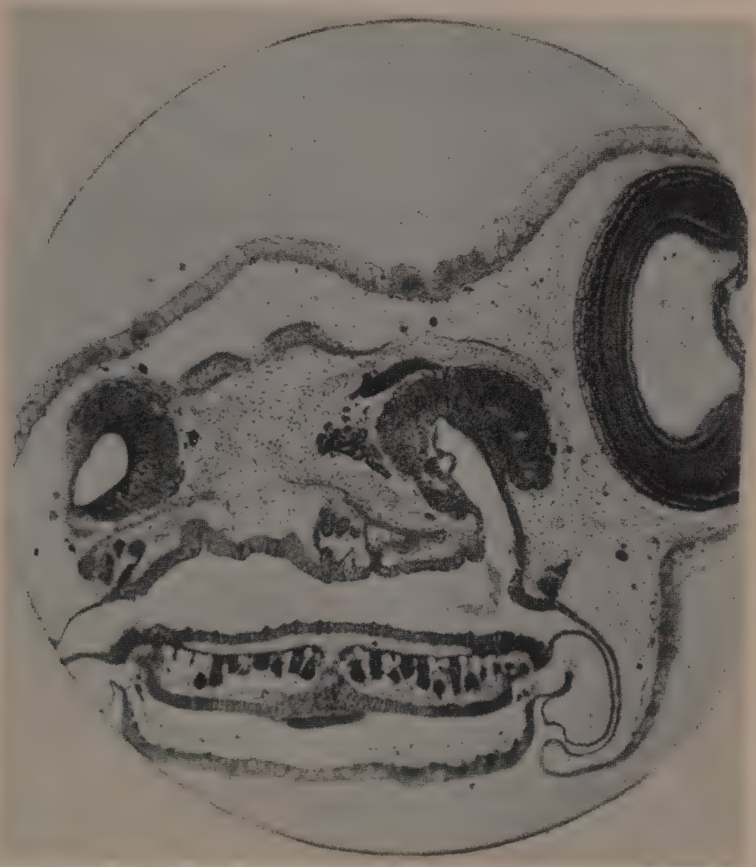

Fig. 3 Photomicrograph of case 104 showing anterior portion of large implanted tigrinum eye extending anteriorly, lateral to the nasal region. × 30.

In spite of this difficulty, it is clear that the enlarged eye exerts a tremendous effect on the surrounding parts. Figure 4 shows a section through the nasal region of one of the operated animals. Not only have the nasal openings been displaced far anteriorly as shown by the measurements in

table 1, but the olfactory lobe and nerve have been carried forward, causing asymmetry in the brain and chondrocranium. This condition, present in all the operated animals, is seen in figure 4.

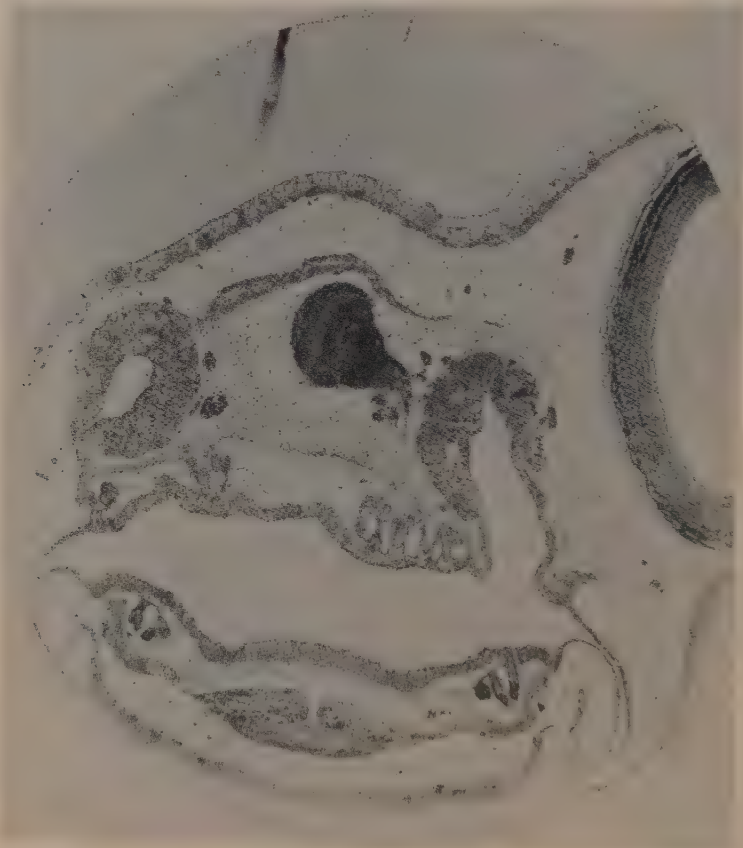

Fig. 4 Photomicrograph of case 104, showing anteriorly displaced olfactory lobe and nerve in the operated side. × 30.

Figure 5 shows a section through a normal animal at the level of the opening of the olfactory pits into the mouth. The symmetry in the chondrocranium, olfactory capsules, olfactory lobes and nerves, and openings of the olfactory pits contrasts to the great asymmetries seen in figures 3 and 4.

Fig. 5 Photomicrograph of punctatum control number 3, showing normal bilateral symmetry of nasal pits, and brain; lack of outer projection of the eyes. × 30.

The otic region is displaced less than the olfactory in all but one case. This is to be expected because there is less to oppose the anterior growth of the eye. Nevertheless, there is some posterior displacement in all the operated animals, and it is pronounced in two of six cases.

DISCUSSION

The results of these experiments show that the eye may exert a powerful influence on the proportions of the chondrocranium. The large eye enlarges the orbit by displacing its

anterior and posterior margins. Steinitz ('06) has shown that the orbit of frogs is reduced in size if one eye is removed. Therefore, both the positive evidence of the transplanted large eye and the negative evidence of the removed eye indicate that there is a close correlation between size of eye and size of orbit during early development.

This correlation lends considerable support to the suggestion of Le Gros Clark ('34) that the narrow interorbital region in Tarsius is, at least in part, secondary to the enormous enlargement of the eyes.

In comparing the results of experiments on mammals with those on amphibian embryos, it should be remembered that in the amphibian not even cartilage is present at the time of operation, nor does it appear before Harrison's stage 42 (Stone, '22; Detwiler, '37). In man the optic vesicle appears during the fourth week while the first appearance of cartilage is not until the sixth week (Arey, '40). These experiments on amphibia would be comparable to experiments on a 5-week human embryo. In the mammalian experiment described previously, effects were limited primarily to the immediate vicinity of the orbit with small associated asymmetries. Apparently maximum results can be attained only if the experiments are performed on early embryos.

The experimental evidence available indicates that the eye exerts a powerful effect on the size of the orbit, if the experiments are performed early enough. How this correlation is greatly reduced in later developments until the low correlation of eye and orbit described by Schultz is encountered is explained by the different growth rates of eye and orbit as discussed previously.

On the basis of these findings the relation of the eye to orbit may be divided into three periods: (1) An early period in which the rapidly growing eye exerts an influence on surrounding parts sufficient to change the proportions of the whole chondrocranium; (2) a later period when the eye is still growing rapidly but the surrounding parts are ossified and effects are limited for the most part to the orbit; and

(3) a still later period in which the eye is growing slowly, if at all, and the orbit may continue to grow independently of the eye.

Correlation of size of eyeball and orbit is high in the first two periods and becomes progressively lower during the third. One's view of the role of the eyeball in orbit formation depends principally on the method employed and the age of the animals studied. In the embryo, studied by heteroplastic transplantation, the developing eye appears as a force displacing all surrounding parts. In the infant the eye exerts slight effects, primarily on the orbit. In the comparative study of adults the eye appears inert, bearing close relation to the size of the orbit.

The form of the adult orbit is the result of the balance of a number of factors which play very different roles at different stages of development. Therefore, many theories of orbital development might seem reasonable, and only experiments show which factors actually do enter into the formation of the orbit. We have tried to show the importance of the eyeball itself early in development. Much work of importance to anthropology, particularly on orbital form in the later stages, remains to be done.

Experimental studies supplement comparative data by extending observations over a whole series of situations which are beyond the range of normal variation. Such studies make possible an extension of comparisons and descriptions which is equivalent to finding a whole new world. In this new world, situations are simpler than in nature because one part can be experimentally altered and the effect of one change judged. Furthermore in the new world are precisely the animals needed to test anthropological theories.

Anthropologists have welcomed the discovery of new lands and deeper explorations into the old. What anthropologist was not thrilled by the discovery of the pygmy chimpanzee or the latest find of Pithecanthropus? The world of experimental anthropology awaits exploration. In it live the animals demanded by our theories, the missing links nature will never provide.

SUMMARY

Physical anthropology is a comparative science, but during the course of comparisons problems of explanation and interpretation arise. Some of these problems have been the subject of debate for many years and seem to be insoluble by purely descriptive means. Many of these old controversies can be settled by the use of experimental methods.

The relation of the size of the eyeball to the size of the orbit serves as an example of such a problem and shows how experimental data may be used to increase understanding and test the soundness of theories.

When the optic vesicle of Amblystoma tigrinum is implanted into Amblystoma punctatum, the grafted eye grows much larger than the host's eye, displaces the olfactory region anteriorly and the otic region posteriorly, thus enlarging the orbit. In the embryo the growing eye is a force, capable of displacing the surrounding parts. Normal orbital development occurs only if a normal eye is in the orbit. The role of the eye in orbit formation becomes clear only after experimental work and is not apparent in purely comparative studies.

LITERATURE CITED

Arey, L. B. 1940 Developmental Anatomy. 4th ed. Philadelphia.

Burr, H. S. 1916 The effects of the removal of the nasal pits in Amblystoma embryos. J. Exp. Zool., vol. 20, pp. 27–51.

——— 1930 Hyperplasia in the brain of Amblystoma. J. Exp. Zool., vol. 55, pp. 171–191.

Cameron, J. 1920 Contour of orbital aperture in representatives of modern and fossil hominidae. Am. J. Phys. Anthrop., vol. 3, pp. 476–488.

Chase, H. B., and E. B. Chase 1941 Studies on an anophthalmic strain of mice. I. Embryology of the eye region. J. Morph., vol. 68, pp. 279–302.

Clark, W. E. Le Gros 1934 Early Forerunners of Man. London.

Detwiler, S. R. 1929 Anatomy as a science. Science, vol. 70, pp. 563–566.

——— 1934 An experimental study of spinal nerve segmentation in Amblystoma with reference to the plurisegmental contribution to the brachial plexus. J. Exp. Zool., vol. 67, pp. 395–441.

——— 1937 Observations upon the migration of neural crest cells, and upon the development of the spinal ganglia and vertebral arches in Amblystoma. Am. J. Anat., vol. 61, pp. 63–94.

Detwiler, S. R., and R. L. Carpenter 1929 An experimental study of the mechanism of coordinated movements in heterotopic limbs. J. Comp. Neur., vol. 47, pp. 427–447.

Fick, L. 1859 Neue Untersuchungen über die Ursachen der Knochenformen. Marburg.

Gudden, B. 1876 Recherches expérimentales sur la croissance du crane. (Translated from the German by Auguste Forel). Paris.

Hale, F. 1937 The relation of maternal vitamin A deficiency to microphthalmia in pigs. Texas State J. Med., vol. 33, pp. 228–232.

Hamburger, V. 1942 A Manual of Experimental Embryology. Chicago.

Lesshaft, P. 1892 Grundlagen der Theoretischen Anatomie. Erster teil. Pp. 99–105. Leipzig.

Martin, R. 1928 Lehrbuch der Anthropologie. 2nd ed., Jena.

Miller, R. A., and S. R. Detwiler 1936 Comparative studies upon the origin and development of the brachial plexus. Anat. Rec., vol. 65, pp. 273–292.

Richardson, D. 1932 Some effects of heteroplastic transplantation of the ear vesicle in Amblystoma. J. Exp. Zool., vol. 63, pp. 413–445.

Rony, H. R. 1940 Obesity and leanness. Philadelphia.

Schultz, A. H. 1930 The promise of a youthful science. Johns Hopkins Alumni Mag., vol. 18, pp. 185–206.

——— 1940 a The size of the orbit and of the eye in primates. Am. J. Phys. Anthrop., vol. 26, pp. 389–408.

——— 1940 b Growth and development of the chimpanzee. Contrib. to Embryol., No. 170. Carnegie Inst Wash., Pub. 518, pp. 1–63.

——— 1941 Growth and development of the orang-utan. Contrib. to Embryol., No. 182, Carnegie Inst. Wash., Pub. 525, pp. 57–110.

Sheldon, W. H. 1940 The varieties of human physique. New York.

Steinitz, E. 1906 Über den Einfluss der Elimination der embryonalen Augenblasen auf die Entwicklung des Gesamtorganismus beim Frosche. Arch. f. Entwech. der Organ, vol. 20, pp. 537–578.

Stone, L. S. 1922 Experiments on the development of the cranial ganglia and the lateral line sense organs in Amblystoma punctatum. J. Exp. Zool., vol. 35, pp. 421–496.

Todd, T. W., H. Beecher, G. H. Williams and A. W. Todd 1940 The weight and growth of the human eyeball. Human Biology, vol. 12, pp. 1–20.

Twitty, V. C. 1932 Influence of the eye on the growth of its associated structures, studied by means of heteroplastic transplantation. J. Exp. Zool., vol. 61, pp. 333–374.

Twitty, V. C., and H. A. Elliott 1934 The relative growth of the amphibian eye, studied by means of transplantation. J. Exp. Zool., vol. 68, pp. 247–291.

Warkany, J., and R. C. Nelson 1941 Skeletal abnormalities in the offspring of rats reared on deficient diets. Anat. Rec., vol. 79, pp. 83–100.

Washburn, S. L. 1942 Skeletal proportions of adult langurs and macaques. Human Biology, vol. 14, pp. 444–472.

Weidenreich, F. 1941 The brain and its role in the phylogenetic transformation of the human skull. Trans. Am. Phil. Soc., N. S., vol. 31, pp. 321–442.

Wessely, K. 1920 Ueber Korrelationen des Wachstums (nach Versuchen am Auge). Zeit. f. Augenheilk., vol. 43, pp. 654–681.

INVESTIGATIONS IN THE PHYSICAL DEVELOPMENT OF NEGROES

I. STATURE

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INTRODUCTION

The aim of this study was to investigate the tempo of physical growth of the American Negro and simultaneously to carry out a comparative racial study. To this end I assembled data — chiefly at the Riverdale Orphanage, Harlem Clinics and Public School no. 136, all in or near New York City, on stature, weight, cephalic index, onset of puberty and environmental trends. The entire material was reviewed from the standpoint of the relative qualitative weight of the two basic elements — heredity and environment — which affect the process of growth; and their relation to the life cycle.

The data are restricted largely to females because in them the age at sexual maturity — a land mark in the cycle of growth — can be determined with accuracy.

Unfortunately, there is no way of determining exactly the degree of White admixture in this Negro material. In the study of puberty, subjects were included only when it was established by questioning that there were no known white parents or grandparents. The same holds for the study of cephalic index. As for the study of stature, neither in the cross-sectional nor the follow-up data could this control be definitely applied.

[1] The investigation was carried out under the auspices of the Columbia University Council for Research in the Social Sciences and was directed by the late Prof. Franz Boas.

An acknowledgment to the persons and institutions whose kind cooperation made this study possible, will appear at the end of the author's entire report.

Although my single measurements merely supplement those reported by others, my consecutive measurements on Negroes are perhaps unique and have an intrinsic value in so far as such follow-up data are of great value in the study of rates of growth.

Reference will be made in the text to data which Prof. Franz Boas put at my disposal; and, unless a publication is mentioned where such data have been utilized previously, the figures cited by me are to be considered as original.

Attention should be called to the changing type of population in those institutions where consecutive observations on growth were obtained in the past. In former years orphan asylums admitted the children because they were destitute, but now the main premise for admission is the existence of behaviour problems; and it is the policy not to place the balanced children in the institution proper for any length of time. An institution which until now has yielded a random population whose main characteristic was its state of poverty, in the future will not segregate a similar series. Therefore, it will hardly be possible again to obtain a "normal," i.e., unselected sample, in Riverdale Orphanage where I had the privilege to collect consecutive data for the study of growth and the onset of puberty.

In view of the fact that my observations pertain to fairly distinct phases of growth, it is convenient to report them separately. The part presented first, deals with stature. The problems pursued in this section are:

1. How does the tempo of growth of the American Negro compare with that of Whites?

2. Is there a secular increase in stature among Negro children similar to the phenomenon observed among Whites?

3. Does the adult stature of the most recent generation of Negroes show an excess over that of earlier generations?

Wherever necessary, the data of Melville J. Herkovits ('30) will be included in the study for the purpose of comparison. The criteria for comparability will be discussed in the text.

TABLE 1

Mean (centimeters) and sigma of stature by age.

AGE	NO.	MEAN	SIGMA	NO.	MEAN	SIGMA	NO.	MEAN	SIGMA	INCREMENT FOR COMBINED SERIES
					Females					
Harlem Clinics; Single measurements: 1935–1936										
21– 89 days	70	56.0	± 3.6							
90–179 days	82	64.1	± 4.5							
180–269 days	68	68.4	± 3.0							
270–359 days	41	72.0	± 2.8							
12– 17.9 months	54	77.0	± 5.1							
18– 23.9 months	30	81.9	± 5.8							
Riverdale Orphanage; Consecutive measurements leading up to 1935										
2– 2.9 yrs.	5	82.8								
2– 3.9 yrs.	18	87.6	± 8.7							
4– 4.9 yrs.	41	96.3	± 6.8							
5– 5.9 yrs.	82	103.2	± 7.2							
6– 6.9 yrs.	130	110.3	± 6.9							
7– 7.9 yrs.	190	116.9	± 6.4		*Public School 136*			*Riverdale Orphanage*		
8– 8.9 yrs.	254	122.0	± 6.9		*Single measurements:*			*and Public School 136*		
9– 9.9 yrs.	304	127.1	± 6.9		*1936–1937*			*combined*		
10–10.9 yrs.	328	132.2	± 7.3	16	143.5	± 4.4	344	132.7	± 7.6	
11–11.9 yrs.	316	137.4	± 7.6	104	146.4	± 6.6	420	139.6	± 8.4	6.9
12–12.9 yrs.	272	143.3	± 7.7	276	152.1	± 7.0	548	147.7	± 8.6	8.0
13–13.9 yrs.	235	148.7	± 7.6	424	154.9	± 6.1	659	152.7	± 7.3	4.9
14–14.9 yrs.	167	152.6	± 6.9	474	156.9	± 6.3	641	155.8	± 6.7	3.1
15–15.9 yrs.	121	155.0	± 6.7	321	158.0	± 6.4	442	157.2	± 6.6	1.3
16–16.9 yrs.	59	156.3	± 7.1	198	158.5	± 6.1	257	158.0	± 6.4	.7
17–17.9 yrs.	17	156.5	± 7.2	48	158.1	± 5.1				
					Males					
Harlem Clinics; Single measurements: 1935–1936										
21– 89 days	82	57.0	± 4.0							
90–179 days	73	63.8	± 3.7							
180–269 days	47	70.1	± 2.6							
270–359 days	41	72.8	± 3.3							
12– 17.9 months	40	79.3	± 3.7							
18– 23.9 months	33	84.6	± 3.5							

THE CHRONOLOGICAL RISE IN HEIGHT AND THE PREMENARCHEAL ACCELERATION OF GROWTH

I have collected 4745 [2] height measurements on Negro girls between 21 days and 17.9 years of age and 316 measurements on Negro males between 21 days and 33.9 months of age. These are assembled in table 1 for comparison between Negro girls and boys from 3 weeks of age to the second year of life. The height of the male infant excels that of the female for all corresponding age groups, except one.

The measurements from the Riverdale Orphanage show smaller averages than those found at the Public School for the age groups between 10 and 18 years. The smaller stature of the orphanage children can be explained by their poorer socio-economic background.

The children between 10 and 14 years of age from the Public School have a taller stature than those reported by Herskovits ('30, table XVIII). When comparing the averages of the age groups between 15 and 17 years from the Public School with the corresponding means of Herskovits identical values will be seen. This would indicate that a deficiency in growth during childhood or adolescence is made up later by a slow increase in height towards the end of the growth cycle, so that the ultimate statures become approximately the same.

It is significant that we find the greatest increment for Negresses between 11½ and 12½ years, namely, 8.0 cm. Herskovits' series has the greatest increment at the same age, namely, 7.8 cm.

When my data from table 1 are combined with those of Herskovits for his groups from 2 to 24 years of age, there results a series of 6326 measurements on Negro females, which are shown in table 2.

From this table it appears that the average chronological increment in stature shows three conspicuous accelerations — the first between 2½ and 3½ years of age, the second between 4½ and 5½, the third between 11½ and 12½ years. The first two

[2] Additional measurements (289) made by me on Negro adult females in 1941 are discussed in the text.

accelerations must be considered as accidental and caused by the scanty material between 2 and 5 years. This interpretation is substantiated by data obtained by Woodbury ('21) on a very much larger population, for the corresponding age groups

TABLE 2

New data combined with those of M. J. Herskovits: Negro females.

AGE	NUMBER	MEAN IN CENTIMETERS	SIGMA	INCREMENT
21– 89 days	70	56.0	± 3.6	
90–179 days	82	64.1	± 4.5	8.1
180–269 days	68	68.4	± 3.0	4.2
270–359 days	41	72.0	± 2.8	3.4
12– 17.9 months	54	77.0	± 5.1	4.9
18– 23.9 months	30	81.9	± 5.8	4.9
2– 2.9 years	26	85.3		
3– 3.9 years	53	93.0	± 7.4	7.7
4– 4.9 years	64	97.8	± 6.9	4.8
5– 5.9 years	142	106.0	± 7.4	8.1
6– 6.9 years	207	112.5	± 7.3	6.5
7– 7.9 years	284	118.1	± 6.9	5.6
8– 8.9 years	333	122.6	± 7.0	4.4
9– 9.9 years	358	127.7	± 7.0	5.1
10–10.9 years	398	133.0	± 7.6	5.3
11–11.9 years	472	139.8	± 8.4	6.7
12–12.9 years	610	147.8	± 8.4	8.0
13–13.9 years	703	152.7	± 7.4	4.9
14–14.9 years	690	155.7	± 6.8	3.0
15–15.9 years	511	157.3	± 6.5	1.5
16–16.9 years	361	157.9	± 6.2	.5
17–17.9 years	142	158.2	± 6.5	.3
18 years	176	159.2	± 5.6	
19 years	155	159.9	± 6.4	
20–24 years	248	159.4	± 7.3	

of his material do not show any excessive increment (compare Woodbury's figures which I have included in table 9). The third acceleration ($11\frac{1}{2}$ to $12\frac{1}{2}$ years) is genuine and corresponds to the premenarcheal spurt in growth occurring one year prior to sexual maturity. That spurt is preceeded and from $12\frac{1}{2}$ years on followed by a diminution in tempo of

growth. In my material the average age at puberty for 1308 cases belonging to the poor Negro population in general and including data from the Riverdale Orphanage is 13.10 years, uncorrected, and 13.42 years, corrected.[3]

In view of the fact that the premenarcheal growth acceleration coincides chronologically among Whites and Negroes, as Boas ('40 a) has shown, it will be of interest to compare the intensity of the spurt in Negroes with that in Whites. Baldwin, Busby, and Garside ('28) have published means on height and weight derived from Whites ("a good class of English speaking people"), and made over a period of several years for each individual. It must be noted that this material represents a rather small group and the consecutive measurements could not have been carried out for the whole range of development for all the children; moreover, puberty data were not furnished by the authors. However, since the age of acceleration tallies with my findings, a comparison of the premenarcheal increment seems permissible. Using the material tabulated by the above mentioned authors (page 69) we find an increment of 10.9 cm. for girls at the age between 11½ and 12½ years. Unless we are dealing with a chance result of a small group, this high figure would suggest that a very intense spurt before maturity is not a racial characteristic per se.

There remains to point out that Boas ('40 a, pp. 128–129) used the Riverdale Orphanage data to illustrate (his fig. 22) another physiologic phenomenon; namely the greater intensity of growth among the individuals whose puberty sets in earlier. Boas first described this phenomenon in Whites in 1932.

SECULAR CHANGES IN STATURE AMONG NEGRO CHILDREN

Average stature now available for American Negroes enable us to approach the problem of whether the present generation of this race partakes in the increase of height noted among the white populations in those sections of America and Europe

[3] The purpose and technique of correcting puberty data will be discussed in detail in the section on puberty.

where the standard of living has improved.[4] However, the question to what degree the level of existence of the Negro has changed during the past two decades, cannot yet be answered conclusively, since we have no comprehensive survey on this problem. (A few relevant facts which were furnished by cooperating agencies will be cited in the section on environmental trends.)

Data obtained in the Riverdale Orphanage for the years 1900 to 1935 disclose that the children of that institution have reached a higher stature during the more recent years than two and three decades earlier. Moreover, the increase in height took place among all the age groups.

Table 3, for the preparation of which I am indebted to the late Professor Franz Boas, shows averages for the stature of the Riverdale Orphanage children arranged according to the date of birth in quinquennial intervals.[5] From these figures we can see that this population underwent a marked increase in stature.

The secular height changes in the Negro population of the Riverdale Orphanage between the years 1900 and 1935 inclusive, are in need of an explanation. The first question is: Is there any relationship between the age of the child and year of birth? Table 4 answers this negatively by showing that the average year of birth is about the same for all age groups.

The second question is: How does the length of stay in the orphanage affect stature? An analysis of annual measurements shows that there is an influence of the environment on stature until the fifth year of the children's sojourn in the orphanage: a definite improvement in growth is noticeable.

[4] Hebrews of New York, measured in 1909 and also in 1935–1936, showed the following percentual increase in stature, taking the earlier measurements as standard: Males plus 6.5, Females plus 2.6 (Boas, '40 b). For recent references on and also for a discussion of the increasing stature see Stewart, '43.

[5] Comparative graphs for various populations have been published by Boas ('40 a, page 122, fig. 15), including a graph for the Riverdale Orphanage material.

TABLE 3

Stature in centimeters at each age for those born in a quinquennial period: Riverdale Orphanage Negro females.

AGE	1900–1904	1905–1909	1910–1914	1915–1919	1920–1924	1925–1929	TOTALS
5		(3) 101.1	(12) 100.7	(9) 104.8	(39) 101.1	(19) 108.7	(82) 103.2
6		(6) 108.8	(23) 105.8	(16) 111.2	(52) 110.2	(34) 113.1	(131) 110.2
7		(12) 113.0	(27) 113.1	(26) 117.4	(82) 116.7	(43) 120.2	(190) 116.8
8	(1) 107.9	(17) 117.3	(33) 117.5	(44) 122.0	(110) 123.0	(49) 125.1	(254) 122.1
9	(5) 126.2	(26) 121.9	(36) 122.9	(56) 127.3	(131) 128.4	(50) 129.7	(304) 127.2
10	(11) 128.5	(30) 126.4	(36) 128.3	(70) 131.8	(152) 134.0	(29) 137.0	(328) 132.3
11	(17) 133.8	(34) 131.7	(37) 134.7	(75) 138.8	(153) 139.5		(316) 137.6
12	(19) 138.9	(32) 137.7	(34) 141.6	(78) 145.4	(109) 145.3		(272) 143.5
13	(20) 144.2	(30) 143.3	(30) 147.3	(74) 151.0	(80) 151.1		(234) 149.0
14	(19) 148.7	(18) 148.4	(19) 149.9	(66) 154.0	(44) 155.8		(166) 152.8
15	(15) 150.6	(13) 150.3	(15) 153.2	(60) 156.7	(18) 157.9		(121) 155.0
16	(5) 148.6	(8) 151.1	(5) 159.7	(40) 157.9			(58) 156.3
17	(1) 143.5	(2) 149.8	(1) 161.2	(13) 158.0			(17) 156.4

TABLE 4

Average year of birth of children at various ages.

AGE	NO.	AVERAGE YEAR OF BIRTH
5	81	1921.0
6	126	1920.6
7	184	1920.5
8	246	1920.2
9	296	1919.6
10	314	1918.6
11	295	1917.3

However, it levels off with the prolongation of stay in the orphanage. Apparently the children entering the orphanage are markedly undersized; and the first few years of institutional care increase their stature to the norm of their age group. This is shown in table 5.

TABLE 5

Effect on stature of length of stay in Riverdale Orphanage.

LENGTH OF STAY	MEAN DEVIATION IN CENTIMETERS FROM MEAN STATURE OF ORPHANAGE POPULATION
0– .99 years	— 1.4
1–1.99 years	+ .2
2–2.99 years	+ .1
3–3.99 years	+ 1.3
4–4.99 years	+ 1.9
5–5.99 years	+ 1.2
6–6.99 years	+ 1.0
7–7.99 years	+ 1.2

The third question is: Have there been any improvements in the general hygienic and nutritional policy of the Riverdale Orphanage since 1900? I could not obtain any evidence along these lines. However Boas ('35) was able to determine that the reorganization of the Hebrew Orphan Asylum in New York City was followed by a general improvement in the development of the children therein.

The fourth question is: Was there during the more recent years an accidental or preferential admission of children from better economic levels? We have no positive evidence on this point. So far, only one fact, though of unknown cause, can be pointed out, namely, the higher initial stature at entrance of the Riverdale Orphanage during the more recent years. This uninterrupted upward trend is illustrated by table 6.

TABLE 6

Initial stature in centimeters of 11-year-old girls on entrance into the Riverdale Orphanage.

TIME OF ADMISSION	NO.	MEAN	SIGMA
1915–1924	28	136.5	± 7.4
1924–1929	16	138.5	± 7.3
1929–1941	39	142.0	± 7.7

The 11-year age group admitted in the years 1934 to 1941 had an average excess in height of 5.4 cm. over the same age group admitted in the years 1915 to 1924.

In the wake of the general economic depression, children from the very poorest environment entered the institution during the past decennium. Nevertheless, the average stature of twenty-four girls, 11 years old, admitted in the years 1930 to 1934, was 141.8 cm. Comparing this figure with the average height obtained for the corresponding age group who already had had the benefit of institutional care in the years 1910 to 1914 (thirty-seven girls; see table 3) we find an increase of 7.1 cm. for those admitted 2 decades later.

It must be conceded that the general trend would appear more certain if similar data were available for all age groups. Unfortunately, supplementary figures could be obtained only on girls 6 years of age (table 7). They show also an increase

TABLE 7

Statures of Negro females, 6 years of age, on admission to the Riverdale Orphanage.

TIME OF ADMISSION	NO.	MEAN IN CENTIMETERS
1915–1919	11	110.8
1920–1924	18	113.1
1925–1929	31	118.0
1930–1934	34	116.7
1935–1939	8	117.2

in stature on entering the Riverdale Orphanage during each consecutive quinquennium. It may be noted however that during the depression period from 1930 to 1934 the statures were lower than in the preceding quinquennium.

At this point I wish to refer to the statures of children obtained by Aleš Hrdlička about 1898 in the New York Colored Orphan asylum. The number of children measured is very small, but they indicate low values as compared with those obtained during the following decades in the Riverdale Orphanage.

Continuing with our questions (fifth): Has the particular social group from which the Riverdale Orphanage received the children undergone a betterment of its economic status, in spite of the seemingly low standard? Since this aspect cannot be analyzed on account of lacking data, the question must be left open.

TABLE 8

Statures (centimeters) of Negro girls in the New York Orphan Asylum (Hrdlička, 1899).

AGE	NUMBER	MEAN
3	2	83.9
4	2	90.6
5	4	98.5
6	2	109.1
7	9	112.7
8	5	126.0
9	10	125.7
10	8	129.5
11	9	130.7
12	3	146.7
13	1	147.7
14	2	155.9
15	2	154.5

Another issue must be clarified, namely, whether the composition of the racial stock in the population of the Riverdale Orphanage has undergone any changes. In general, the same type entered the institution. Recently, however, there was a slight increase of admissions of children who had come from the South in early childhood. This increase of children with a Southern ascendancy set in about the year 1930. But it must be emphasized that if the place of nativity were a factor determining the height values, then it would not explain the progressive increase in stature from 1900 until 1929 as shown in tables 3 and 6.

Additional material of previous investigators can be used to study secular changes in stature of Negro children. In table 9 I compare measurements, obtained in 1919 by R. M. Woodbury with the data obtained by M. J. Herskovits between the years from 1923 and 1926, and with my series, partially ex-

tracted in 1935 from the reports of the Riverdale Orphanage and partially consisting of my measurements at the Department of Health Clinics in Harlem, New York City, in the year 1936.

TABLE 9

Stature (centimeters) of Negro girls by three observers in different years.

AGE	MICHELSON 1935–1936 [1]		WOODBURY 1919 [2]		HERSKOVITS 1923–1926 [3]	
	No.	*Mean*	*No.*	*Mean*	*No.*	*Mean*
1– 2.9 months	70	56.0	201	54.7	..	....
3– 5.9 months	82	64.1	254	61.4	..	....
6– 8.9 months	68	68.4	179	66.1	..	....
9–11.9 months	41	72.0	167	68.9	..	....
12–17.9 months	54	77.0	245	73.8	..	....
18–23.9 months	30	81.9	200	79.3	..	....
2–2.9 years	5	82.8	361	86.8	21	85.9
3–3.9 years	18	87.6	379	94.8	35	95.8
4–4.9 years	41	96.3	337	102.2	23	100.6
5–5.9 years	82	103.2	187	107.8	60	109.8

[1] 0–23.9 months from Harlem D. O. H. Clinics, 1936; 2–5.9 years from Riverdale Orphanage, N. Y., 1935. Technique: A measuring frame constructed under the author's direction, was placed on a table and the infant put on its back; the legs were held in extension. One side of the frame was made high enough so as to permit the contact between this wall and the infant's head. A sliding board was moved toward the infant's feet. The reading of the stature was made from marks on both opposite long sides of the frame. Errors could be reduced to a possible minimum since the contact with the infant's heels and with the marks on the frame's longitudinal sides formed one straight line. Older children who were able to stand, were measured with the anthropometer. All individuals were measured without shoes.

[2] 1921, table 18, p. 104.

[3] 1930, p. 101.

The 1936 series of the Department of Health Clinics reveals a higher average stature for the age group from 1 to 23.9 months than the corresponding 1919 series of Woodbury. For the age groups between 2 and 5.9 years the 1935 Riverdale Orphanage series shows the lowest mean statures, and Herskovits' material (1923 to 1926) resembles that observed by Woodbury 15 years earlier.

Thus we see that the Negro infants who are under the care of the Department of Health,[6] have a marked increase in

[6] A discussion of the nutrition of the infants supervised by the Department of Health of New York City, will be given in the section on environmental trends.

stature over the preceding Negro generation. The Riverdale Orhpanage children, as may be observed for the group between 5 to 5.9 years of age (eighty-two measurements) are still undersized.

For white children the smaller bodily size of the less privileged social classes has been pointed out by Franz Boas. Paralleling table 5 b on page 315 of Professor Boas' "Studies in Growth" ('32) with my mean statures for the Negroes (table 1), we note that the latter are smaller [7] than the Hebrew and Gentile better-to-do class and taller than the Hebrew orphans and general Hebrew population of either American or European birth. This applies to all age groups from the sixth year on.

Through the courtesy of Dr. Nellie Marmor who obtained measurements on White infants brought up on the same diet as the Negro series from the Department of Health, we can compare the stature of White and Negro children born since 1935. Moreover, we can compare the White infants of this generation with those measured in 1919.

Table 10 a shows that the Negro boys and girls of the years 1935–1936 are taller than the Negroes measured in 1918–1919. For the girls this observation has been recorded already. White male and female infants of this generation likewise are taller than the Whites measured in 1918–1919.

The White children of the present generation are taller than the Negro children born in the same year. Woodbury's data from 1919 showed a similar excess in favor of the Whites.[8]

[7] As already mentioned, an apparent growth acceleration of the Negroes between 2 and 3 years and between 4 and 5 years is presumably due to chance, the series for these age groups being very small.

[8] One must keep in mind that the relative greater length of the extremities in Negroes than in Whites affects the comparability of the stature of the two races. If the proportion between the length of the lower extremities and the spine follows a different racial pattern, that factor might influence the amount of the excess in height of the White over the Negro child belonging to the same age group. However, the problem of the consecutive changes in the bodily proportions as they may occur during the growth cycle, could not be investigated in the present study; nor could morphological racial differences in the curvature of the lower spine and the tilting of the pelvis be considered here.

TABLE 10 a

Comparative heights of White and Negro infants 1935–1936 vs. 1918–1919.

AGE IN DAYS	WHITES						NEGROES			
	Woodbury ('21) 1918–1919 (Gen. pop.)		Woodbury ('21) 1918–1919 (N. Y. City)		Marmor[1] 1935–1936		Woodbury ('21) 1918–1919		Michelson[2] 1935–1936	
	Males									
	No.	*Mean*	*No.*	*Mean*	*No.*	*Mean*	*No.*	*Mean*	*No.*	*Mean*
1– 89	3780	57.8	1826	56.5	64	59.0	203	55.6	82	57.0
90–179	5498	64.2	2027	62.4	115	67.8	231	62.8	73	63.8
180–269	5509	68.9	1600	68.0	110	73.5	173	66.5	47	70.1
270–359	5512	72.3	1273	71.3	70	77.8	146	70.2	41	72.8
360–449	4220	75.5	1063	74.0	36	80.3	101	73.3	27	78.1
450–539	3822	77.1	856	77.0	23	84.4	93	76.6	13	81.7
540–629	3666	81.4	729	80.0	17	87.4	108	79.4	18	83.9
630–719	3826	83.7	664	82.3	13	90.5	102	81.6	15	85.4
	Females									
1– 89	3534	56.6	1723	55.4	64	58.3	201	54.7	70	56.0
90–179	5327	62.6	1937	61.8	117	64.8	254	61.4	82	64.1
180–269	5389	67.4	1495	66.5	96	71.2	179	66.1	68	68.4
270–359	5243	70.8	1251	69.7	58	75.9	167	68.9	41	72.0
360–449	3985	73.9	1075	72.8	37	79.1	122	72.2	27	75.9
450–539	3749	76.8	805	75.7	14	84.5	123	75.4	27	78.0
540–629	3690	80.1	719	78.6	8	85.0	108	78.2	15	82.8
630–719	3563	82.2	694	81.2	8	87.3	92	80.6	15	81.0

[1] Low income group; same care as in Department of Health Clinics, New York City.
[2] Department of Health, Harlem Clinics, New York City.

It is interesting to note that the Negro children up to two years of age who were under the dietary and general supervision of the Department of Health of the City of New York in the years 1935–1936, are taller than the children of the general White population measured in 1918–1919.

Table 10 b presents a 1940–1941 series of White females resembling in its composition Marmor's males and females of 1935–1936, and a 1941 series of Negro females, resembling my series of 1935–1936. This control study, although based on

TABLE 10 b

Comparative heights of White and Negro female infants: 1940–1941.

AGE IN DAYS	WHITE MARMOR, 1940–1941 [1]			NEGRO MICHELSON/MARMOR, 1941 [2]			EXCESS OF WHITE OVER NEGRO
	No.	Mean	Sigma	No.	Mean	Sigma	
360–449	78	79.2	± 2.8	23	78.4	± 3.2	+ 0.7
450–539	43	83.0	± 3.5	19	82.2	± 2.4	+ 0.7
540–629	26	85.5	± 3.5	30	83.5	± 2.8	+ 2.0
630–719	11	85.8	± 3.7	17	86.1	± 2.9	— 0.2

[1] Low income group; same care as in Department of Health Clinics, New York City. Total of 164 measurements on 96 children.

[2] Mt. Morris Park Station, Department of Health, New York City; single observations.

insufficient numbers, bears out the findings of the years 1935–1936. As a matter of fact, the series of 1941 shows for Negro female children a further slight increase in stature during the most recent quinquennium.

THE STATURE OF THE ADULT FEMALE NEGRO

I have tried to get information on the problem of whether the present adult female Negro generation which has just completed physical growth, is taller than the preceding generation. I have made measurements on female Negroes whose average year of birth is $16\frac{1}{2}$ years later than that of the group measured by Herskovits. My series embraces a population grown up in the North; however, many individuals are not of local origin, but have migrated from the South or the West Indies to New York during childhood.

In table 11 are listed height measurements obtained in 1941 on 289 females, 16 to 24 years old, representing a cross section of various socio-economic groups. The entire series may be considered as an unselected series of the general adult female population of New York City. From table 12 it is evident that the series measured in 1941 has exactly the same average stature as that obtained for the corresponding age group by Herskovits in 1923 to 1926.

TABLE 11

Stature of adult female Negroes of New York City in 1941.

AGE	NO.	MEAN	SIGMA
16 years–16 years, 11 months	13	159.3	± 4.6
17 years–17 years, 11 months	28	160.1	± 3.8
18 years–18 years, 11 months	37	158.4	± 5.1
19 years–19 years, 11 months	40	158.8	± 6.8
20 years–24 years, 11 months	171	159.8	± 6.4

TABLE 12

Comparison of adult female Negro statures: 1941 vs. 1923–1926.

AGE	MICHELSON, 1941		HERSKOVITS, 1923–1926	
	No.	*Mean*	*No.*	*Mean*
18 years to 24 years, 11 months	248	159.4	579	159.5
20 years to 24 years, 11 months	171	159.8	248	159.4

The apparent stability of the stature of the female Negro adult is in striking contrast to the secular increase in stature of the Negro children from 1900 to 1941. This can possibly be explained by the unfavorable circumstances in which the Negro grows up. We know of environmental improvements recently introduced in behalf of infants and school children, but we do not know of any permanent, systematic care extended to the Negroes during the period of the entire growth cycle.

However, in evaluating what appears to be a secular increase in stature among Negro children from 1900 to 1941 and also what seems to be a stability in stature among Negro adults between 1923 to 1941, one has to take into account the uncertainty of the provenience of the population. The composition of the various series may be quite different. For ex-

ample, we know that Negroes from Cuba and those from Porto Rico are not derived from the same African sources. Unfortunately, the material on hand precludes a clarification as to the racial comparability of the various series.

In my opinion the criteria for comparability of Herskovits' and my data, established both before and after my study are:

1. Homogeneity of overt physical characteristics.
2. Wide geographic heterogeneity of birth.
3. Situs of the studies: New York City.
4. Cross section of all social and economic groups represented.
5. Relative secular stability in regard to the subsistence level, in comparison to other population sectors.
6. Great instability of residence in any given locality.
7. Apparent lack of infiltration of white blood.

The favorable intervention of philanthropy and public health have not as yet effected any secular stabilization upward of the final stature of the Negro. Secular stability of final stature could be deduced from the data on hand, providing further rationale for comparability, although this a posteriori reasoning may also be interpreted from the point of view of coincidence.

In interpreting the rhythm of growth as a phenomenon irrespective of racial considerations, the essential point is the differentiation between two aspects of growth. On the one hand there are the effects of acceleration of development.[9] On the other hand we know from studies of various investigators on Whites that the total adult population has increased in stature. In other words, there must be one factor which is due to acceleration and which has no effect upon the final stature and another element which leads to the general increase in stature regardless of acceleration.

As far as the Negroes are concerned, the present material does not suggest a physiologically determined increase of the

[9] Boas, '32, page 324, points out that individuals of the same social environment show quite different rates of growth due to acceleration and retardation which lead to the same adult stature.

final stature during the most recent period of time. It seems to be safe to conclude that the increase in stature of the Negro children who have been under the hygienic and nutritional management of the Department of Health, can at least in part be attributed to this environmental factor and that we are possibly dealing with an accelerated growth. Whether the same individuals will at the end of their growth cycle excel in height over the adult stature of previous generations, is an open question.

A complicated aspect would be the probable stifling of an initially favorable development on account of a lack of lasting beneficial environmental factors, since deprivation during the years of adolescence or later, may possibly annul the advantage gained in infancy or childhood. All these issues need further clarification, which cannot be done without long-range consecutive observations and control studies.

A NOTE ON THE ADULT STATURE OF THE MALE AMERICAN NEGRO, WITH SPECIAL REFERENCE TO ARMY ANTHROPOMETRY

In view of the seeming lack of secular change in the adult female Negroes I tried to utilize the statistics of the War Department on the statures of the Civilian Conservation Corps in order to obtain an answer to the question of whether the present adult male stature differs from that of previous generations. The data are given in table 13.[10]

The enrollees of the CCC represent selected material in view of restrictions as to the stature prior to enrollment. Moreover, the present tabulation of the CCC figures does not separate the Southern from the Northern population and applies to Negroes from all sections of the United States, as was pointed out to the author in a communication from the War Department.

The exclusion from the CCC series of undersized men and the combination of data obtained on men of different geographic origin, renders a comparison between this compilation and older studies unreliable.

[10] I am indebted to Col. Ino W. Meehan of the Office of the Surgeon General for these data.

The validity of a comparison of the measurements which Gould (1869) obtained on Colored soldiers of the Civil War with Herskovits' measurements in the years 1923 to 1926, depends on several criteria. The men of the Civil War were admitted without limitation as to height and represent a northern Negro population. However, the generation measured by Herskovits is a population of a more homogeneous nature than that of their ancestors of the Civil War period.

TABLE 13

Negro enrollees in Civilian Conservation Corps: mean heights by age group at entrance into the Corps (men discharged between April 1, 1938 and March 1, 1940).

AGE	URBAN		RURAL	
	No.	*Mean*	*No.*	*Mean*
17	579	170.3	229	171.3
18	1001	171.1	678	171.5
19	919	170.9	747	172.2
20	649	171.9	660	172.2
21	432	172.0	519	172.8
22	379	171.5	405	173.0
23	218	172.0	227	171.9
24	65	172.6	52	172.6
25–28	40	169.9	23	174.0
Total	4282	171.3	3540	172.2

NOTE: Urban is defined by Bureau of the Census as that population residing in a closed community of 2,500 or more persons, the remainder being classified as rural.

There were more pure Negroes, more first generation mulattoes and more people with a greater admixture of Indian blood in the earlier than in the later period. Additional factors are continuous migrations from the South of the United States, from the West Indies, and from South America, to the North of the United States; the influx of rural inhabitants to the northern urban regions and the fusion of the migrant populations with those already settled in the North. However, the nineteenth century northern urban community had a higher rural character than that of the twentieth century and this environmental factor may have had a bearing on the population, including stature.

With all the above mentioned reservations in mind, one may compare Gould's and Herskovits' height measurements. For the age group 20 to 24 years old, Gould obtained the average of 66.81 inches, i.e., 169.74 cm. Herskovits obtained 171.1 cm., which amounts to an increase of 1.4 cm. in favor of the later born generation. It is an open question whether that figure has any real meaning.

The height measurements made by Davenport and Love on 6454 Negro recruits of the First World War can, unfortunately, not be compared with the 7822 Negroes of the CCC. Even assuming that the exclusion of too small or too oversized men applied equally to both series, there still remains the fact that the series of Davenport and Love contains mainly men belonging to the southern population while the CCC series is a combination of southern and northern Negroes, their distribution not being specified in the statistics on hand.

At this time we lack a sufficient number of comparative data enabling us to determine whether there is a recent increase in stature of the male adult Negro. Any conclusions in this respect can be arrived at only by indirection.

Melville J. Herskovits, as it was already mentioned, obtained for male Negroes, 20 to 24 years old (286 cases), the average height of 171.1 cm., $\pm$ 6.3. This value, obtained $1\frac{1}{2}$ decades ago, corresponds to the average height of the urban CCC population 18 years of age. Does this signify a real excess in stature in favor of the later born generation which has not as yet finished its growth cycle? Cross-sectional measurements to be performed on unselected populations, may answer the question whether a secular increase in the Negroes' adult stature is occurring in our era. With the improvement of environmental factors such a physiological change is a possibility.

It is obvious that the War Department's statistics on stature, cited in this paper, are not conclusive on account of the height limitations which determine the type of the source material. A comparable norm representing the average stature of the southern as well as the northern Negro popula-

tion was not furnished by Love and Davenport nor by the Civilian Conservation Corps. It appears that, from the point of view of obtaining valid statistics on stature, the methodology of Army Anthropometry is in need of revision.

This can be realized by an improvement in the practice of assembling data and by more rigid statistical methods. One procedure would be to induce the Draft Boards to record the measurements of the rejected, undersized individuals. Corrections of the data as given now can be made, allowing for the failure to report on the rejected material, provided their total number is given; but such corrected values will never be quite satisfactory.

As far as the tabulation of the statures of draft recruits is concerned, a temporary variation of height standards occurring during one and the same war must be heeded; and it goes without saying that the source material must be classified in accordance with the place of nativity of the subjects under study.

In my opinion, the minimal prerequisites for classification of source material are: separate tabulation of statures of Negroes born and remained in any given locality; migrants to that locality classified as to age at migration; place or places, if any, of intervening migration and length of stay; life history of the individual with respect to participation in social and economic groups, public health and philanthrophy. It must be noted here that the above prerequisites somewhat overstep the limits of Army anthropology, which nevertheless, might possibly reorient itself in terms of the program outlined herein.

SUMMARY AND CONCLUSION

1. A correlation between the rhythm of growth and the onset of puberty of Negro females is in conformity with similar observations made on Whites by other investigators.

2. Negro children measured in the Riverdale Orphanage, New York, showed an increase in stature between the years 1900 and 1940. The cause of this could not be determined.

3. Negro infants who have been under the dietary regime of the Department of Health, New York City, showed an increase in stature as compared with corresponding age groups studied two decades prior (R. M. Woodbury). It is probable that the increase found in the later born series is due to the environmental factor. The higher statures of the supervised group may be the result of accelerated growth. It cannot be predicted whether an increase in the adult stature, i.e., a physiological change, will take place in the supervised groups at the completion of the growth cycle.

4. In spite of the recent increase in stature of Negro children, the latter are smaller than the corresponding age groups of Whites of the same generation.

5. The present adult female Negro population in New York City appears to be of the same stature as the adult female Negro population measured in New York City during the years 1923 through 1926 by M. J. Herskovits. This is in contrast to the secular increase in the final stature of female Whites of New York City as observed for the corresponding generation.

6. In interpreting the components of growth factors as a whole, two aspects must be differentiated. First, factors which lead either to retardation or acceleration of growth, neither exerting any influence on the final stature. Second, another element which effects an increase in the adult stature among succeeding generations, regardless of retardation or acceleration during the process of growth.

7. It stands to reason that the lack of an increase in the adult stature of the Negro may be due to a lack of long lasting environmental improvements. However, this hypothetical consideration must also be weighed against another, as yet not clarified factor; namely, in the Negro the stability in physical characteristics might possibly be greater than in Whites.

8. Army anthropology could contribute to a study of the adult male Negro stature provided an adequate methodology is used. This has reference to selection and classification of material, statistical approach and evaluation of data.

LITERATURE CITED

BALDWIN, BIRD T., LAURA M. BUSBY AND HELEN V. GARSIDE 1928 Anatomic growth of children. Univ. Iowa Studies, First Series, no. 164, 88 pp.

BOAS, FRANZ 1932 Studies in growth. Human Biology, vol. 4, pp. 307–350.

——— 1935 The tempo of growth of fraternities. Proc. Nat. Acad. Sci., vol. 21, pp. 413–418.

——— 1940 a Race, Language and Culture. New York.

——— 1940 b Age changes and secular changes in anthropometric measurements. Am. J. Phys. Anthrop., vol. 26, pp. 63–68.

DAVENPORT, CHARLES B., AND ALBERT G. LOVE 1921 Army anthropology. Washington, D. C.

GOULD, B. A. 1869 Sanitary Memoirs of the War of the Rebellion. U. S. Sanitary Commission, New York.

HERSKOVITS, MELVILLE J. 1930 The anthropometry of the American Negro. New York.

HRDLIČKA, ALEŠ 1899 Anthropological investigations on 1000 white and colored children. Wynkoop Hallenbeck Crawford Co., New York and Albany.

STEWART, T. D. 1943 Food and physique. Ann. Am. Acad. Polit. Soc. Sci., vol. 225, pp. 22–28.

WOODBURY, R. M. 1921 Statures and weights of children under 6 years of age. Community Child Welfare. Ser. 3, Children's Bureau Publ., no. 87, 117 pp.

REVIEWS

MAN'S POOR RELATIONS. By Earnest Hooton. Doubleday, Doran & Co., Inc., Garden City, N. Y., xl + 412 pp., 1942. ($5.00.)

Probably more has been written about the Primates, even excluding man, than about almost any other mammalian order. The literature not only is voluminous, but also widely scattered, and even the professional primatologist has great difficulty in keeping up with other than his own particular portion of the field. The present work is an attempt to bring together, under one cover, the salient features of our present knowledge of apes, monkeys and lemurs. In assessing it, the very real difficulties of the task constantly must be kept in mind.

In producing this book, Professor Hooton has performed a distinct service to biologists, for it makes available, in a comprehensive manner, many of the more recent investigations of primatologists. Indeed, there is nothing quite comparable to it in the English language. Hence it should prove of great value to workers in cognate fields. By its nature, it is of necessity a compromise between a popular and a strictly scientific work. Perhaps no one other than the author could so effectively have written a book of this type. Certainly the active specialist in primatology would suffer from too many acute inhibitions.

The book is arranged in five parts, dealing respectively with the anthropoid apes, the Old World monkeys, the New World monkeys, the tarsiers and lemurs, and a limited morphological comparison of man and other primates. It is, however, neither a textbook nor a handbook, since the treatment of the material seems largely to have been dictated by the author's personal interests. Hence some subjects are discussed in minute detail, while others receive but passing mention.

The author has a thorough knowledge of the literature that deals with the habits and psychology of Primates, and he presents this view of the order in his customary stimulating manner. But his treatment of the anatomical and physiological aspects leaves much to be desired. This is to be regretted, since our ideas of relationships and phylogeny necessarily are based largely upon morphological studies. Most of the anatomical information, far too scant for even a book of this character, appears almost like an afterthought. Furthermore, it obviously is based chiefly upon the books of Sonntag — which is both incomplete and now largely out of date — and Wood Jones — which is limited in scope and not always accurate. The carefully

arranged bibliography published by Ruch would quickly have led to other, more recent sources of information. To judge from the comparative section, primates are compounded of skin, bones and teeth, with a dash of blood and brain. Nor does the chapter devoted to the last-named structure, being based entirely upon the book of Tilney, give other than a meager idea of our knowledge of this organ. One finds no reference, for example, to the important studies of Brodmann, LeGros Clark, Elliot Smith, Fulton, Hines, and Sherrington.

There are a number of errors of statement and certain doubtful interpretations:

Man's thumb is not the relatively longest among primates (p. xxxvi). Relative to the other fingers, it is equalled or even surpassed by some platyrrhines, such as Cebus and certain marmosets.

To say that a speech area, even though undeveloped, occurs in the brains of great apes, contravenes our present knowledge (p. xxxvii) — for cortical areas 45, 47 and 48 appear to be peculiar to man.

The author seems to have completely misunderstood the relationships of abdominal viscera and peritoneum (pp. 2–3). Mesenteries are not restricted, as indicated, to the anthropoid apes and man. Indeed, these structures are phylogenetically ancient. Nor do they anchor the abdominal organs in the sense implied by the author. Visceral fixation is rather consequent to absence of the primitive mesenteries; but to state that such fixation in man was "certainly derived . . . . from ape ancestors," does not necessarily follow, for some visceral fixation is not uncommon in Old World monkeys.

The thumb of the gorilla may be "not so degenerate-looking as that of other apes" (p. 70), but it surely is much more retrogressive than those of chimpanzee and Hylobatidae when muscles are considered in addition to skeleton.

To deny the gorilla the ability to independently move its fingers is to impugn the animal (p. 70); for quite the contrary is indicated by cerebral stimulation, as in the studies of Leyton and Sherrington.

Sternal glands are not peculiar to the orang-utan, having been described also for Ateles (p. 119).

It is difficult to see wherein the blood supply to the human buttocks suggests that man's ancestors may have had ischial callosities (p. 124). Indeed, the great vascularity of this region in man suggests quite otherwise to the reviewer. Perhaps the author was thinking of the sexual skin, for he repeatedly confuses the latter with the ischial callosities (pp. 178, 201, 222, 234).

The nomenclature of the Lemuroidea is somewhat jumbled, and the hattock, Mixocebus, is incorrectly termed Myoxicebus (pp. 289, 313).

The digital formula of lemurs is given as 4–5–3–2–1, whereas it more commonly is 4–3–5–2–1 (p. 319).

It is impossible to give a typical vertebral formula for lemurs. Certainly one showing 12 thoracic, 7 lumbar, 3 sacral and 27–28 caudal vertebrae is not the rule (p. 320). Galago, Chirogaleus and Microcebus usually possess 13 pairs of ribs, Loris 15, Perodicticus 14 to 16, and Nycticebus 16. Galago and Perodicticus commonly have 6 lumbar segments, Avahi, Loris and Propithecus 8, Indris and Lepilemur 9. Indris may have either 3 or 4 sacral vertebrae, Loris from 2 to 5, Nycticebus 5 or 6, Perodicticus 6 or 7. The caudals vary extremely, and Indris and the lorises may exhibit as few as 7.

A true cecal appendix is not the rule in lemurs (p. 320). This structure occurs only in Lorisinae, and then merely in individual instances.

In citing the important comparative study of Reichert and Brown on hemoglobin, their significant findings are completely reversed (pp. 335–336). It is not the heme fraction that varies, but the globin portion — and this pertains not only to primates, but also to all varieties of hemoglobin yet studied.

''Cerebellum'' is not equivalent to ''hind brain,'' nor are ''neopallium'' and ''cerebrum'' synonyms of ''forebrain'' (p. 342).

It is extremely doubtful that most workers would agree with the statement that ''teeth and skull bones are perhaps the most instructive parts of the body in regard to the habits, relationships, structure and adaptations of any animal'' (p. 368). Leaving aside the nervous system and other soft parts, one thinks at once of the skeleton of the extremities. Indeed, it perhaps is not going too far to state that our present meager knowledge of the details of human phylogenesis is to a very considerable extent due to the lack of such fossil material. Skull and teeth of course are important and instructive, but with all too evident limitations.

None of the errors of commission and omission in themselves are serious, nor do they impair the general usefulness and high quality of the book. Indeed, they appear to be remarkably few when one considers the enormous scope that has been covered. But it appears necessary to bring them to the reader's attention, for books seem to possess a peculiar aura of authority, and to have the habit of being quoted in preference to shorter, original papers. Since the present volume appears destined to exert a deservedly wide influence, inaccuracy, however understandable, is all the more to be regretted.

This is a ''must'' book for anthropologists. For, as the author states, ''the anthropologist rarely, if ever, studies any other animal than man.'' When he does, it might be added, he usually limits himself to the anthropoid apes and assumes that their characters necessarily are more primitive than those of man. Certainly Professor Hooton is not afflicted by any such limitations or delusions. In the

present volume he not only has produced a work of great charm and worth, but also one that may influence the perspective of future anthropological studies.

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PALMAR AND PLANTAR DERMATOGLYPHICS IN PRIMATES. By CHARLES MIDLO AND HAROLD CUMMINS. The American Anatomical Memoirs, no. 20. The Wistar Institute of Anatomy and Biology, Philadelphia. 198 pp., 601 figs. (of which 593 show the ridge patterns in members of 35 primate genera), 9 tables, bibliography (pp. 194–198) of 96 titles by 60 writers.

While carrying out their study of the ridge patterns on primate palms and soles Doctor Midlo and Doctor Cummins examined members of no less than 35 primate genera ranging from Daubentonia to Homo. The results of this work are presented in a volume recently issued by The Wistar Institute, Philadelphia.

In addition to abundant human material the specimens on which this work was based number 478 hands and 440 feet of lemurs, monkeys and great apes. Furthermore the patterns on 75 hands and 109 feet have been analyzed from previously published illustrations.

The sequence of stages in ridge evolution gives evidence that these ridges have been developed from the specialized scales that probably covered the larger part of the body surface in ancient mammals (in recent mammals these scales, in modified form, occasionally persist, especially on tails and paws).

In their palmar and plantar dermatoglyphics man and the great apes are specialized in different directions. Especially in his adherence to the basic plan of ridge configuration man is more primitive than even the orang. Inasmuch as that plan is a very fundamental characteristic we may safely conclude that man stemmed from an ancestral stock more primitive than that represented by any existing anthropoid, a stock that had dermatoglyphic traits more resembling those of monkeys than those of the great apes.

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REPORT ON SKELETONS EXCAVATED AT OLYNTHUS. By JOHN LAWRENCE ANGEL. Pp. 211–240 in David M. Robinson, "Excavations at Olynthus, Pt. XI, Necrolynthia, a study in Greek burial customs and anthropology," Johns Hopkins Press, Baltimore, 1942. ($15.00.)

The nine skulls featured in this report were recovered from the Riverside Cemetery at Olynthus in May–June, 1938. Of the nine

only five are at all complete; four are males, five females, averaging 30–35 years of age. All were warped and fragmented when uncovered. The burial dates covered are mid-sixth century to 384 B.C. Craniometric techniques are basically those of Martin.

The author uses a type comparison as the basis of his analysis. Over a period from 3000 B.C. to 1300 A.D., twenty-three types, in six basic groups, are set up; the area of comparison is mainly Attica, Corinth, Argolis, and Cephallenia. Angel defends his approach as follows: "The careful use of types can lead to a more dynamic analysis of the chronological and geographic changes in a varying population of any fixed culture area than can the use of all-inclusive averages alone, since these, even with the addition of correlations between measurements, fail to give any clear picture of the different kinds of individuals whose differing characters and backgrounds made up the cultural life of any community or group of communities."

The six types are as follows: type A, a rugged long-head akin to the "Megalithic" of Coon, or Atlanto-Mediterranean of Deniker; type B, a gracile long-head akin to Sergi's Eurafrican; type C is Alpine; type D is long-headed, Mixed Nordic or Ancestral Nordic, akin to Coon's "Corded" or "Hallstatt Nordic"; type E is a Mixed Alpine type; type F is termed Dinaric-Mediterranean. The skulls from Olynthus are synthesized by Angel into an "average Olynthian": type A, Rugged Mediterranean, 25%; type B, Small Mediterranean, 12%; type D, Mixed Nordic, 10%; type F, Dinaric-Mediterranean, 3%; type E, Mixed Alpine, 20%; type C, Alpine, 30%. The "average" is highly synthetic.

The racial history of Macedonia is suggested: early Mediterraneans, both rugged and gracile, plus Corded and Danubian types; hybridization resulted in Dinaricization. With time Alpine influence increased so that by Classical times a Mixed Alpine type was dominant.

The report in its entirety is a model of the archeological interpretation of burials and burial customs. To the brilliant archaeology of Robinson there is added the equally brilliant physical anthropological analysis of Angel. The nine skulls, by means of the type-analysis method, fall into place in a much more comprehensive view of Time and Space.

W. M. Krogman
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HANDBOOK OF LATIN AMERICAN STUDIES. 1941, No. 7. A selective guide to the material published in 1941 on anthropology, archives, art, economics, education, folklore, geography, government, history, international relations, labor and social welfare, language and literature, law, libraries, music and philosophy. By Miron Burgin, editor for The Joint Committee on Latin American

Studies of The National Research Council, The American Council of Learned Societies and The Social Science Research Council. Harvard University Press, Cambridge, Mass, xv + 649 pp., 1942.

This annual selective bibliography has grown in 7 years to over two and a half times its original size and has become one of the most useful research tools in the field. The growth of the Handbook reflects the inclusion of other fields and an effort to be more comprehensive in the listing of the literature.

The section on anthropology, occupying 41 pages in the present number, is divided as usual into six parts, which, with the current authors, are as follows: Anthropology: general (pp. 38–39); Middle America: Archeology, by George C. Vaillant (pp. 40–46); Middle America: Ethnology, by Ralph L. Beals (pp. 47–52); South America: Archeology, by Alfred Kidder, II (pp. 53–59); South America: Ethnology, by Alfred Métraux (pp. 60–74); Middle and South America: Physical Anthropology, by T. D. Stewart (pp. 75–78). Each part is headed by a general statement and contains an annotated bibliography arranged by countries.

The general statement prepared by Métraux on his subject in this number is especially noteworthy since it includes a survey and formulation of some of the problems of South American anthropology. Because of his extensive experience in South America and his familiarity with the literature, Métraux speaks as one of the foremost authorities.

The part on physical anthropology lists twenty-four items, of which six are by North American scholars. The number of items in this subject listed each year have remained fairly constant. However, they will probably reach a peak in the next number ('42) as a result of the increased interest in this field. A subsequent recession already can be detected as a result of the war.

There is one disadvantage to an annual bibliography, although fully indexed, and that is the necessity of going through an increasing number of volumes in search of references. There have been proposals for a summary volume at intervals of 10 years or so. A more useful project, so far as anthropology is concerned, is planned in connection with the Handbook of the Indians of South America, which the Bureau of American Ethnology is preparing. This project envisions an annotated bibliography of all the anthropological literature on South America, including those already published in the Handbook under review, with a classificatory index. Praiseworthy as the Bureau's project may be, it still does not provide for the accumulating literature of the future. This, then, is the important contribution of the Handbook of Latin American Studies; that it provides a reasonably complete, authoritative and continuing review of the literature within about a year of publication.

T. D. STEWART.

NOTES

PERSONNEL

The editor, Dr. T. D. Stewart, will be on furlough from the National Museum for 6 months beginning July 1st for the purpose of teaching anatomy at Washington University School of Medicine, St. Louis, Mo.

Sherwood L. Washburn is Acting Secretary-Treasurer of the *American Association of Physical Anthropologists* in the absence of W. W. Howells who is now a lieutenant in the Navy.

Other members of the Association in the services include the following:

Lt. P. B. Candela, Army
Lt. Marshall T. Newman, Navy
Lt. Col. George D. Williams, Army

ANNUAL MEETING OF THE ASSOCIATION

Owing to difficulties in transportation and the fact that many members are engaged in work essential to the war, the *American Association of Physical Anthropologists*, like most other scientific societies, will not hold an annual meeting this year. However, since the terms of certain officers expire this year, the President, Prof. Wm. K. Gregory, has appointed a Nominating Committee consisting of Prof. E. A. Hooton, chairman, Lt. W. W. Howells and Dr. T. D. Stewart, to prepare a list of candidates. Ballots for the election of officers are being sent to members in good standing.

PROPOSED CHANGES IN THE BY-LAWS

The Executive Committee of the *American Association of Physical Anthropologists* has prepared certain changes in the by-laws required to formalize the new relations of the Journal and the Association (see Proceedings of the thirteenth annual meeting, this Journal, vol. 29, pp. 313–315). Also, minor changes have been proposed to make the by-laws accord with the actual practice of the Association. Members are requested to study these changes so as to be prepared to vote upon them when the next meeting can be held.

To aid comparison the present and proposed versions are here given side by side:

Art. II, sec. 2. Slightly revised to accord with actual practice.

Present wording

At the annual meeting preceding that of election, the President shall appoint a Nominating Committee of three members. This Committee shall report its nominations to the Secretary no less than two months before the annual meeting. The Secretary will then mail the list to all members at least one month before the meeting. Additional nominees for any office may be offered in writing to the Secretary by any five members at any time previous to the election.

Proposed wording

The President shall appoint a Nominating Committee of three members, before the annual meeting, to offer nominations for vacancies for elective offices at the meeting. Additional nominations for any office may be made from the floor, if supported by five members.

Art. III, sec. 2. At present this article consists of a single section. It is proposed to reword present Art. VIII and add it here as section 2.

Present wording

Sec. 1. Committees. Members of the Executive Committee will be elected at the annual meeting of the Society on nomination by the Nominating Committee. One member of the Executive Committee shall be elected annually.

Sec. 2. All other committees, including the Nominating Committee, will be appointed by the President after approval by the Executive Committee.

Proposed wording

A member of the Executive Committee, exclusive of the officers of the Association, shall be elected annually to serve for three years.

Art. VI. In addition to extensive rewording of the whole article, it is proposed to delete present section 3 and to remove the reference to it in present section 5 (new section 4). The Committee could not agree on changing or eliminating section 2 and this question may be brought up for discussion at the next meeting.

Present wording	*Proposed wording*
Sec. 1. Dues: Annual, active, and associate memberships. The annual dues of both active and associate members shall be $2.00. A member in arrears for dues for three years shall be dropped after due final notification, but may be reinstated at the discretion of the Executive Committee on payment of his arrears.	*Sec. 1.* Dues, annual. These shall be $2.00 plus the amount of the annual subscription to the American Journal of Physical Anthropology. A member in arrears after two years shall be dropped.
Sec. 2. Life-membership — active. The life-membership fee for active members shall be $25.00. Twenty per cent of such life-membership fees may be employed for current expenses of the Society. Not less than 80 per cent shall be added to permanent endowment of the Society.	*Sec. 2.* Life-membership — active. The life-membership fee for active members shall be $25.00. Twenty per cent of such life-membership fees may be employed for current expenses of the Society. Not less than 80 per cent shall be added to permanent endowment of the Society.
Sec. 3. Life-membership — associate. Associate members may become sustaining life members on the payment of $100.00.	
Sec. 4. Benefactors. Upon approval of the Executive Committee, any person may, on payment of $500.00 or more, become a benefactor. Benefactors have the status of either active or associate life members according to definitions in article V.	*Sec. 3.* Benefactors. Upon approval of the Executive Committee, any person may, on payment of $500.00 or more, become a benefactor. Benefactors have the status of either active or associate life members according to definitions in Art. V.
Sec. 5. All receipts from sustaining life members and benefactors shall, in entirety, be added to the permanent endowment of the Society or be accepted and used under the approval of the Executive Committee for such special purpose as may be indicated by the donor.	*Sec. 4.* All receipts from benefactors shall, in entirety, be added to the Endowment Fund, or be accepted and used under the approval of the Executive Committee for such special purpose as may be indicated by the donor.

Art. VII. The words "or by-laws" would be added and the sentence beginning "Due notice . . . ." omitted. The change accords with actual practice.

Present wording

Any proposed change in the constitution of the Association must be presented in writing by at least five members at one annual meeting. Such proposal shall be referred to the Executive Committee, and if approved will be presented for vote at the next annual meeting. Due notice of the proposed change will be sent to each member at least one month in advance of the meeting. A two-third vote of members present will be necessary for adoption.

Proposed wording

Any proposed change in the constitution or by-laws of the Association must be presented in writing by at least five members at one annual meeting. Such proposal shall be referred to the Executive Committee, and if approved will be presented for vote at the next annual meeting. A two-thirds vote of members present will be necessary for adoption.

Art. VIII. This is all new (see Art III, sec. 2 above for the proposed disposition of the present Art. VIII).

Proposed wording

Sec. 1. The official organ of the Association shall be The American Journal of Physical Anthropology.

Sec. 2. The Association shall elect the editor of the Journal, to serve for six years.

Sec. 3. The editor shall be assisted by an editorial board of four associate editors, to which the Association shall elect one member annually to serve for four years.

S. L. Washburn
Acting Secretary.

ILLUSTRATIVE MATERIAL IN PHYSICAL ANTHROPOLOGY

There must be available in many different institutions and in the collections of professional workers, an enormous amount of photographic and other illustrative material relating to the general field

of physical anthropology. Would it not be a good idea to make a record of all this material and its location available to all workers?

Photographic negatives, positives, photostats, slides, cine-films, microfilms, drawings, and blocks ready for the printer, all should be recorded, and when the final list has been made up, it should be printed as a supplement to the American Journal of Physical Anthropology. In this way a sort of exchange library would be built up which, in fulfilling its purposes would eventually save considerable time and expense, and avoid much needless duplication.

I would suggest that the present editorial board of the American Journal of Physical Anthropology would be the appropriate body to set such a scheme in motion.

M. F. ASHLEY MONTAGU
The Hahnemann Medical College.

There is a very real need especially for a list of available portraits of racial types. For instance, various war agencies recently have been seeking photographs of Japanese, Chinese, and the inhabitants of the Pacific Islands. Published photographs do not reproduce well as a rule. Who, then, has the original negatives and how can prints from them be procured? A listing of the holders of such negatives in this country, together with the pertinent data, would be feasable as an initial project.

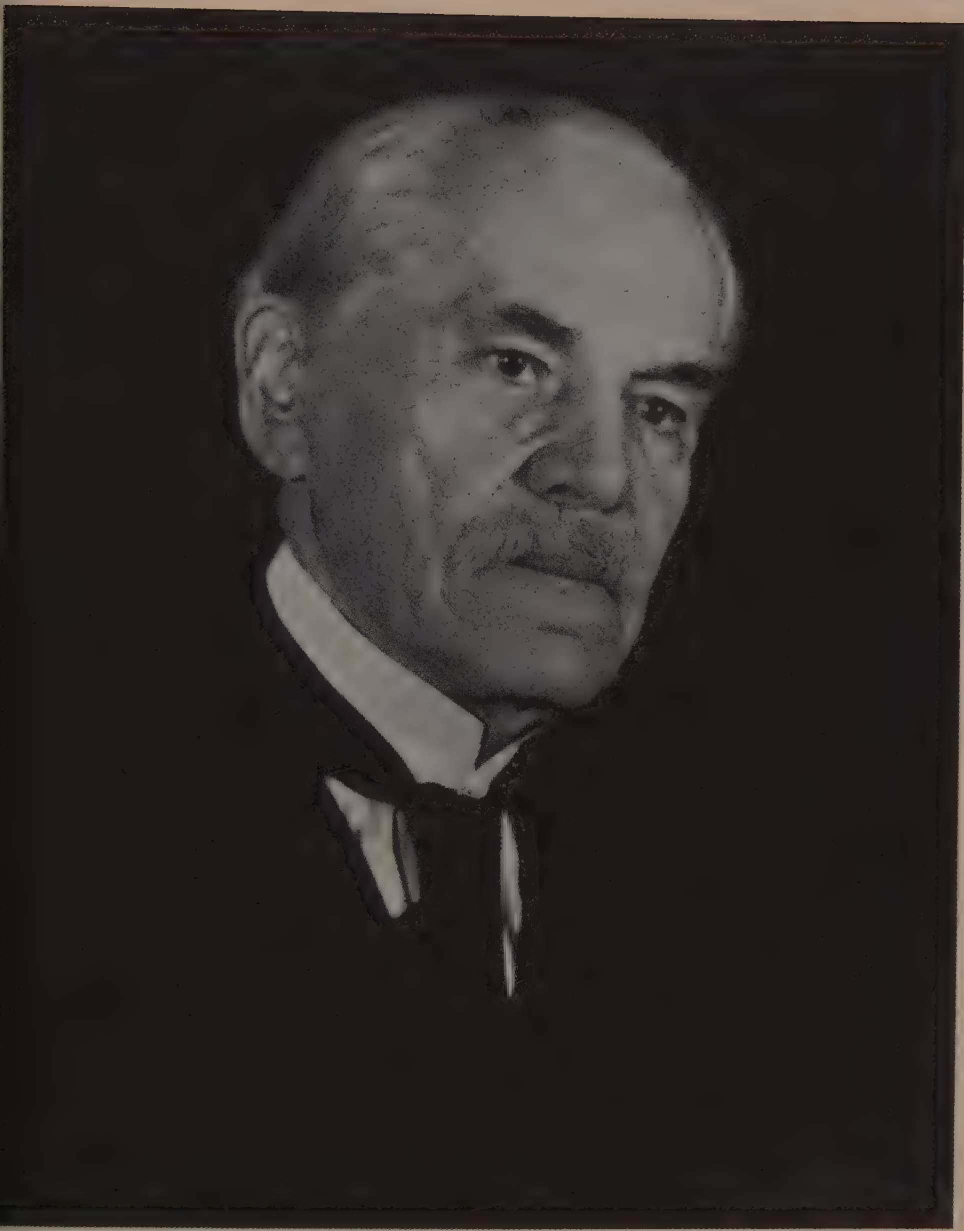
The immediate need for listing the other types of material is debatable. An individual could undertake this work better than the editorial board. — EDITOR.

CONTEMPORARY RUSSIAN CIVILIZATION

During the week of August 16th Dr. A. Hrdlička will conduct a seminar on *Soviet Scientific Achievements* at Cornell University. This seminar will be part of a comprehensive and integrated study of the civilization of the Soviet Union which the University is offering during its Summer Semester, July 5th–October 23rd, "in the belief that the war and our future relations with Russia have made a thorough knowledge and understanding of that country an essential part of American educational experience." Those interested are advised to consult or write Prof. Ernest J. Simmons, 133 Goldwin Smith Hall, Ithaca, New York.

THE MEXICAN CONFERENCE

The Third Round Table Conference of the Mexican Society of Anthropology, a preliminary announcement of which appeared in the last number, will be held in the city of Mexico (México D. F.) from Wednesday, August 25th to Thursday, September 2nd. Those planning to attend are urged to communicate with the secretary, or Dr. Gordon Ekholm of The American Museum of Natural History in New York, by air mail.



Aleš Hrdlička

March 29, 1869 —— September 5, 1943

ANCIENT CEPHALLENIANS

THE POPULATION OF A MEDITERRANEAN ISLAND

J. LAWRENCE ANGEL
Department of Anthropology, University of Minnesota

TWO TEXT FIGURES AND FOUR PLATES

During a period of almost a year and a half devoted to field work in Greece[1] I spent 2 weeks in the late summer of 1938 examining Cephallenian crania in the museum at Argostoli through the kind permission of Dr. S. Marinatos. The rather small series of skulls in restorable and measureable condition comes from five cemeteries all in the relatively low-lying western section of the southern quarter of the island, and all consisting of chamber or beehive tombs with pottery of Submycenaean style and dated by Dr. Marinatos as far back as the earliest twelfth century B.C., the time of the Trojan war.

From Mazarakata there are 17 males and 5 females; from Diakata there is one male and one female skeleton; from Lakkithra 2 males and 2 females; from Metaxata 4 males and 2 females; from Mavrata 7 males and 3 females; in all 31 males and 13 females of which 29 and 11 respectively are useable skulls.[2]

The markedly uneven sex ratio is a result of archeological selection of the toughest crania. Greek skulls in general are very poorly preserved because of porous soil, and sharp seasonal changes in moisture and temperature. The present series comes from tombs of the family vault type, and although in Cephallenia the bodies were usually in separate rock-cut

[1] I should like to thank Dr. E. A. Hooton, Dr. G. H. Chase, Dr. T. L. Shear, and Dr. C. H. Morgan for their foresight, support, and assistance to me in carrying out this project.

[2] These crania were excavated by P. Kavvadias in 1908, K. Kyporissis in 1912–14, and by S. Marinatos in 1934, 1937, and 1938 respectively.

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floor cists and thus were less disturbed by arrival of new occupants than were those in Mycenaean tombs on the Greek mainland, the Cephallenian skulls still are much broken, lack faces, and can seldom be associated definitely with accompanying skeletal parts.[3] The skulls were hardened and mended with Alvar solution and glue.

These Homeric period Greeks from Cephallenia overlap chronologically both the end of the Mycenaean civilization and the beginning of the Early Iron Age phase of immigrations, confusion, and gestation of Classical Greece. The Mycenaean or Late Helladic III series from the Isthmian region of mainland Greece [4] is therefore used as a basis of comparison both for Cephallenians and for mainland Greeks of Submycenaean, Protogeometric, and Geometric periods,[5] here labelled Early Iron Age. Other comparative series listed in tables 1–3 are Minoans from Crete mostly of Middle Minoan date,[6] and Chalcolithic Sardinians from the "Megalithic" rock-cut subterranean chamber-tombs called Witches' Houses,[7] as examples of Mediterranean island populations of early date (late third and early second millennium B.C.). The Basic White Type selected from ancient Greek skulls of all dates from 3300 B.C. to 1300 A.D. is included as a possible key to comparison of Cephallenians with the other series.

Measuring technique is that practiced at the Peabody Museum, and follows Martin's definitions (Martin, '28). Horizontal circumference is taken above browridges. Auricular height is measured to vertex from the poria perpendicular to the Frankfort plane, exceeding the Biometric OH by $.96 \pm .45$

[3] Among the thirty-one males, crania make up 12.9%, calvaria and calvariae each 29.0%, calvae 19.4%, and fragmentary calvae 9.7%.

[4] Attica and Argolis, with three females from Boeotia and Thessaly.

[5] Attica, Corinth, and Argolis.

[6] From W. L. H. Duckworth, 1913, table VI, p. 247, supplemented by measurements of two diameters on some of the same skulls from F. Von Luschan ('13).

[7] Seriated from measurements of G. Sergi ('07), with inclusion of three skulls of doubtful sex but clearly male measurements, and exclusion of unsexed skulls which might have been female. From individual skull measures it seems probable that Sergi sexed some males as females.

mm. (cf. Angel, '43). Midfacial and alveolar angles are measured to and from the point where a straight edge touching the sides of the pyriform aperture rests on the upper surface of the nasal spine.[8] These two angles together with the facial and frontal angles are all taken with reference to the Frankfort plane. Prosthion has a double location following Martin's usage, (Martin '28, p. 620) and basion is similarly given two locations on the anterior rim of the foramen magnum, katobasion or endobasion, for measurement of height or length respectively. Dacryon is used for orbital and interorbital breadths. Duckworth's technique is presumably that of the Biometric school. Minimum frontal and bizygomatic breadths, taken from Von Luschan's data should not differ from my technique. Sergi states that his technique is that of the Monaco conference of April 16–21, 1906, and hence it should coincide with mine. It seems likely, however, that his orbital breadth exceeds true dacryal breadth, and his horizontal circumference also appears exaggerated.

Sixteen characters with an N of 15 or greater are available among male Cephallenians for an estimate of variability from Howells' sigma ratio (Howells, '41, pp. 146–147). This is 104.6% of that of a "normally" variable archeological group, indicating a variability definitely greater than average. And though this is somewhat lesser variability than that (107.01%) shown by the average sigma ratio of the eight period groups into which ancient Greeks can be divided at present, the Cephallenians are definitely more variable than Mycenaean Greeks from around the Corinthian Isthmus, and either exceed or equal the Early Iron Age mainlanders in variability. Use of individual sigma ratios and V's to contrast the variability or relative stability of different measures is a much less certain procedure. But it is notable that Cephallenians combine marked variability in most diameters and arcs with stability in indices. This suggests the juxtaposition of at least

[8] Compared with use of Martin's evanescent nasospinale this technique raises the midfacial angle by ca. 4 degrees, and lowers the alveolar angle by 12–14 degrees, giving more contrast to angular relations of the facial profile.

two racial tendencies which show similarity in proportions but contrast in size, and makes worthwhile a morphological type analysis. The Sardinian sigma ratio [9] likewise exceeds "normal" variability, and the excess in cranial length and cranial index points to types of contrasting headform.

In analysis of the total series of Ancient Greek males six morphological types have been derived through combination of twenty-three mutual resemblance subgroups. Selection and combination was each made almost entirely through comparison of mounted photographs showing from four to six standardized views of each skull. The types chosen are statistically separate from the total series, are less variable than the total series,[10] and resemble groups outside of Greece more closely than they do the total series. Taken in conjunction with the irregularly compartmented geography of Greece and historical fluctuations in ease of communication and general level of economy, the degree of separateness between types explains the high average variability of Isthmian Greece (sigma ratio 107.01%) and underlines the great importance of understanding the parallel course of racial and cultural fusion which accompanies the achieving of creative and successful culture and of a "normal" degree of racial variability in the Mycenaean and Classical periods.[11]

Type A is called Basic White since it is less specialized than the Eurafrican, Atlanto-Mediterranean or Megalithic type, of which it might also be labelled an East Mediterranean-Aegean relative. The vault is large, rugged, and somewhat ill-filled, pentagonoid, somewhat flat-sided and gabled, with lambdoid flattening; long, relatively low, with relatively wide, low, and receding forehead whose heavy browridges project laterally. The broad-jowled and probably low face has rectangular orbits bounded by robust cheekbones, a relatively short and

[9] Based on characters with N greater than 14.

[10] "Derived" sigma ration of 101.9% average for types, contrasted with 111.15% for total series.

[11] See Angel, '42 a, and '42 b, for discussion of types and significance of their blending. I hope that a study of functional interrelationship of racial blending and cultural success can be published soon, based on data from ancient Greece.

coarse nose marked by deep nasion depression, straight nasalia profile, weak spine and perhaps dull borders, and broad U-shaped palate, strong chin, good dentition. The Basic White type closely approaches Chalcolithic crania from Megiddo in Palestine (Hrdlička, '38)[12] and Chalcolithic Siculans from Isnello near Cefalu in N. Sicily, (Guiffrida-Ruggeri, '01, '05), and in terms of raw deviations is as close to both Chalcolithic Sardinians and Neolithic British as it is to the total series of Ancient Greek males.

Type B is the Classic Mediterranean of Sergi, marked by its small gross size, gracility, angular and just dolichocrane vault, with small basal diameters, relatively low, vertical, and narrow forehead, long and bossed parietals, and projecting sharp-bent occiput. The narrowed face has an inverted triangular outline, with square orbits and delicate cheekbones, narrow nose with low root, weak nasion depression, weak spine, pinched and slightly prognathous mouth region with weak and compressed lower jaw, shallow pointed chin, and an overbite linked with little teeth wear. The Mediterranean type is considerably closer to Pre-Roman Libyans from Siwa oasis and to "Modern" Sicilians (Derry, '27; Morant, '28) than to the total series of Ancient Greeks. A composite type resulting from averaging the means of Types A and B represents an average "Mediterranean" population, and approaches identity with the series from Minoan Crete.[13]

Type C is a generalized Alpine type, including both concave-nosed "European" skulls with rounded occiput, and more hawk-nosed and incipiently planoccipital "Eastern" varieties with both high and low vaults. The broad-bulging and short vault ranges from spheroid via short ovoid to sphenoid in form, with full forehead and short and mildly curved occipital bone marked by strong torus. The low, orthognathous, and subnasally shallow face has a rounded square outline, and incipient flatness resulting chiefly from a short, non-projecting,

[12] Unfortunately these skulls are somewhat incomplete.

[13] Except for the mutually discrepant basion-bregma and auricular heights of Duckworth. The Minoan skulls were apparently much broken.

low-bridged and concave-profiled nose, and short and low palate linked with edge to edge bite, well-worn and poor quality teeth without age increase. The Alpine type lies closer to "modern" Carinthian villagers (Shapiro, '29) and to medieval inhabitants of Hythe in Kent than to the total series, but is smaller than Upland Bavarians.

Type D is called Nordic-Iranian because of resemblances to aquiline Iranian crania as well as virtual identity with Reihengräber skulls. It has a large, high, dolichocrane, ovoid-ellipsoid, very well-filled vault with capacious forehead and deep occiput. The rectangular and leptoprosopic face has drooping orbits, big but retreating cheekbones, large, very salient, and concavo-convex nose with big spine, long and high-arched palate and large jaw.

Type E, the Mixed Alpine type, has a strikingly capacious skull vault, mesocrane, with remarkably large frontal bone, and smooth contour broken by obelion-lambda flattening. The face is dwarfed by the braincase, is of inverted trapezoid outling, with wide orbits, high-rooted and non-salient nose, and large but weak jaws. The mixed Alpine type approaches more closely to Romano-Etruscan Tarquinians (Morant, '28) than to the total series.

Type F is called Dinaric-Mediterranean since it has a short, fairly high, mesocrane and byrsoid vault, with pinched forehead. The large face has an elongated hexagonal outline, a long and thin nose whose profile continues that of the forehead, a high palate, and a deep chin. Hence the type comes close to Lower Egyptians as well as to dinaricised Anatolian and Balkan groups.

All the distinctions made for these types in the preceding descriptions are based on statistically significant deviations from the total series. Such chronologically static types are naturally mere descriptive devices. They are plausibly compromises between the actual array of genetic linkage groups in the populations of Greece, the actual individuals marked by varying genetic combinations, and the "average individual" described by metric means. And insofar as the types

may clarify the contrasts which existed between the individuals responsible for the culture of any one region their use is mandatory. Neither imaginary "average men" nor animated clusters of genes form societies. And it is in their generalizing of the varied outward appearance of the Greeks that these types have a real usefulness: with further work they may possibly be extended to surrounding populations also.

The Greeks as a whole, Mycenaean mainlanders, Cephallenians, Early Iron Age mainlanders, and Chalcolithic Sardinians, show the following percentages of these male types:

GROUP	N	TYPE A	TYPE B	TYPE D	TYPE F	TYPE E	TYPE C
Total Greeks	(255)	23.53	23.14	18.43	7.84	10.98	16.08
Mycenaean	(40)	42.50	27.50	7.50	5.00	7.50	10.00
Early Iron	(26)	*11.54*	15.38	11.54	19.23	11.54	*30.77*
Cephallenia	(29)	37.92	31.03	10.35	0	13.80	6.90
Sardinia	(29)	48.2–?	13.8?	6.9?	0?	10.4?	20.7?

Among the females differences are less sharp. Sardinian percentages, since they are based only on Sergi's published measurements, very probably exaggerate the excess of type A over type D. Two facts are at once apparent: first the dominance of the Basic White type, backed up by Mediterranean in all the groups except the Early Iron Age series; and second the dominance of Alpine and hybrid Alpine types in the latter. This suggests the obvious conclusion, illustrated by figure 1 and table 1, that Cephallenians, Sardinians, and Mycenaean Greeks represent older and more basically Mediterranean basin populations than do the Early Iron Age Greeks with their apparent Central or S.E. European modifications. Of the three former groups, the Cephallenians carry the old racial varieties down into the Iron Age, at a time when great racial changes were more marked in mainland Greece. Thus Cephallenia is a marginal or "refuge" area from the racial standpoint.

But in terms of raw differences between group averages the Cephallenians are further removed from both Mycenaean and Early Iron Age mainlanders than these are from each other,

TABLE 1

Submycenaean Cephallenian males compared with mainland Greeks and with East and West Mediterranean Islanders.[1]

CHARACTER	MYCENAEAN GREECE			CEPHALLENIA			EARLY IRON AGE			SARDINIA [2]			MINOANS [3]		
	Mean	*p.e.*	*N*	*Mean*	*p.e.*	*N*	*Mean*	*p.e.*	*N*	*Mean*	*p.e.*	*N*	*Mean*	*p.e.*	*N*
Horizontal circumference	518.00	1.35	32	*524.99	2.46	21	518.15	2.31	18	*_532.83_	2.01	23	515.9		21
Sagittal arc	377.02	1.46	31	377.42	2.28	19	374.18	1.65	19						
Frontal arc	128.88	.62	16	126.66	.95	24	128.98	.71	21						
Parietal arc	129.30	1.13	15	129.46	1.37	23	126.68	1.00	23						
Occipital arc	119.40	1.14	11	119.90	1.10	20	117.68	.77	22						
Transverse arc	308.88	.92	31	307.91	1.55	17	308.76	1.34	23						
Cranial length	185.38	.63	37	*188.48	.95	25	183.96	.72	25	_188.93_	.97	30	186.4		64
Cranial breadth	140.15	.57	39	138.93	.75	27	141.76	.86	25	140.55	.65	29	136.8		50
Basion-bregma height	132.88	.74	26	133.44	.76	18	133.73	.79	22	134.50	.93	14	130.2		20
Auricular-vertex height	115.94	.51	34	115.40	.47	25	115.88	.61	25	117.25	.61	24	118.9		25
Minimum frontal breadth	95.78	.41	37	96.62	.82	21	95.26	.70	19	98.42	.47	24	95.7		10
Maximum frontal breadth	116.04	.68	13	118.68	.91	23	*119.50	.97	18						
Frontal angle	49.97	.50	29	50.40	.36	15	50.45	.51	20						
Basion-nasion length	98.73	.72	26	_102.20_	.61	15	100.42	.72	19	*103.43	1.55	7	100.0		23
Basion-prosthion length	93.25	.74	16	*_99.22_	1.14	9	94.81	.67	16	98.29	1.69	7	95.9		11
Facial angle	86.40	.47	15	84.17	.85	12	87.06	.64	17						
Midfacial angle	94.26	.46	17	_90.50_	.69	13	93.32	.50	17						
Alveolar angle	65.24	1.06	16	64.50	1.41	12	68.24	.82	16						
Bizygomatic breadth	129.25	.87	20	129.62	.67	13	132.53	1.07	19	130.50	1.02	8	126.0		5
Bigonial breadth	101.16	1.80	6	98.00		2	100.26	.88	17						
Facial height	114.83	2.13	6	107.84		3	113.34	.99	19	110		1			
Upper face height	68.41	.62	17	65.27	1.30	11	68.00	.66	19	69.10	.86	10	65.0		13
Nasal height	49.47	.44	19	47.62	.72	13	50.25	.44	20	49.40	.74	10	48.9		13
Nasal breadth	24.00	.28	19	24.50	.27	14	24.35	.27	20	23.20	.28	10	24.2		10
Nasalia angle	57.62	.93	16	_51.78_	1.63	11	55.50	1.64	14						
Upper nasalia breadth	12.12	.21	34	12.43	.28	21	13.16	.47	19						
Lower nasalia breadth	16.93	.49	14	16.62	.43	8	18.17	.31	12						
Left orbit height	33.11	.29	19	_30.73_	.65	11	32.16	.34	19						
Right orbit height	33.11	.35	19	_31.21_	.34	14	32.70	.37	20	*_30.73_	.41	11	31.7		22
Left orbit breadth	38.67	.23	21	38.18	.33	11	39.12	.31	17						
Right orbit breadth	38.94	.30	18	*37.93	.25	14	39.47	.29	19	_40.09_	.39	11	39.5		13
Interorbital breadth	21.59	.21	34	22.43	.28	21	22.18	.36	17						
Biorbital breadth	97.67	.53	27	97.22	.72	18	98.06	.63	18						
External palate length	53.11	.41	18	53.67	.62	12	53.22	.48	18	53.62	1.26	8			
External palate breadth	63.07	.73	15	62.09	.35	11	63.92	.55	13	62.22	.87	9			
Symphysis height jaw	32.60	.80	10	29.75	1.60	4	32.61	.50	23						
Condylo-symphys. length	99.00	2.05	4	103.50		2	103.64	1.21	14						

					[illegible]	[illegible]	[illegible]	[illegible]	24	74.80	.69	27	73.39 *
Length-height index	71.96	.44	26	70.78	.51	18	73.00	.40	22	71.50	.34	14	69.85 *
Length-auricular height	62.68	.35	33	*61.41	.33	22	62.79	.37	24	62.59	.35	23	63.79 *
Breadth-height index	94.65	.65	26	95.94	.66	18	94.07	.85	21	95.79	1.17	14	95.18 *
Breadth-auricular height	82.82	.53	34	83.67	.38	24	81.87	.58	24	83.73	.70	22	86.92 *
Fronto-parietal index	68.12	.36	34	*_70.45_	.45	19	67.50	.59	19	*69.85	.49	23	69.96 *
Cranio-facial index	91.50	.64	20	*93.50	.50	13	92.56	.58	18	93.62	1.37	8	92.10 *
Zygo-frontal index	73.22	.58	18	75.12	.56	13	72.50	.59	16	_75.75_	.59	8	75.95 *
Fronto-gonial index	109.50	1.67	6	99.00		2	106.00	1.25	14				
Zygo-gonial index	77.50	.62	6	76.50		2	75.77	.80	15				
Facial index	89.83	2.22	6	84.50	3.67	3	85.62	.93	17	84.7		1	
Upper facial index	52.83	.72	15	50.00	1.07	10	51.15	.62	17	52.50	.48	7	51.59 *
Nasal index	48.50	.83	19	51.67	1.17	12	48.50	.53	19	46.90	.79	10	49.49 *
Left orbital index	85.17	.92	18	80.68	1.70	11	83.56	.87	17	*_76.70_	1.24	11	80.25 *
External palatal index	120.00	1.41	14	_113.90_	1.48	10	116.75	1.67	12	115.87	2.18	8	
Dominant head form	Pentagonoid			Long pentagonoid			Short pentagonoid			Ellipsoid			
Brow ridges	Rugged			Medium			Small						
Forehead & frontal	Low, narrow, sloping, & weak contour.			Low, medium, erect, & constricted			High, erect, & well-bossed						
Parietal	Bossed & lambdoid flattening			Scaphoid, bossed, & lambdoid flat			Smooth with flat vertex						
Temporal	Medium			Somewhat flat			Full. Small mastoids.						
Facial outline	Trapezoid			Square			Hexagonal						
Facial profile	Concave			_Prognathous_			Retreating						
Orbits & cheekbones	Angular; prominent.			Rounded; compressed			Rhomboid; large						
Nose	Weak, conc-straight, with small spine			Coarse, concave, & _projecting_			High, with strong nasal spine						
Mandible	Big chin & angles			Compressed			Retreating chin						
Bite & teeth	Sl. over; medium			Overbite; good			Edge bite; fair						
Mean V L., Br., AuH., Min. Fr	3.65		36.7	4.18		24.5	4.01		21.3	3.79		26.7	
Mean V of 16 diameters	4.71		26.7	5.30		17.4	5.04		19.4				
Mean σ 10 Indices, 1 Angle	3.98		26.4	3.40		17.2	3.71		20.4				
Mean sigma ratio (N>14)	99.29%	(30)	23.8	104.58%	(16)	20.9	102.19%	(35)	20.1	108.64%	(7)	25.7	
Stature in cm.	158.84		6	163.32		10	161.08		14	Short (?)			

[1] Differences from the Mycenaean series between 2.50 and 2.99 x p.e. are starred, those between 3.00 and 3.99 x p.e. italicized, and those above 4.00 x p.e. both starred and italicized. [2] Sergi, '07. [3] Duckworth, '13, and Von Luschan, '13.

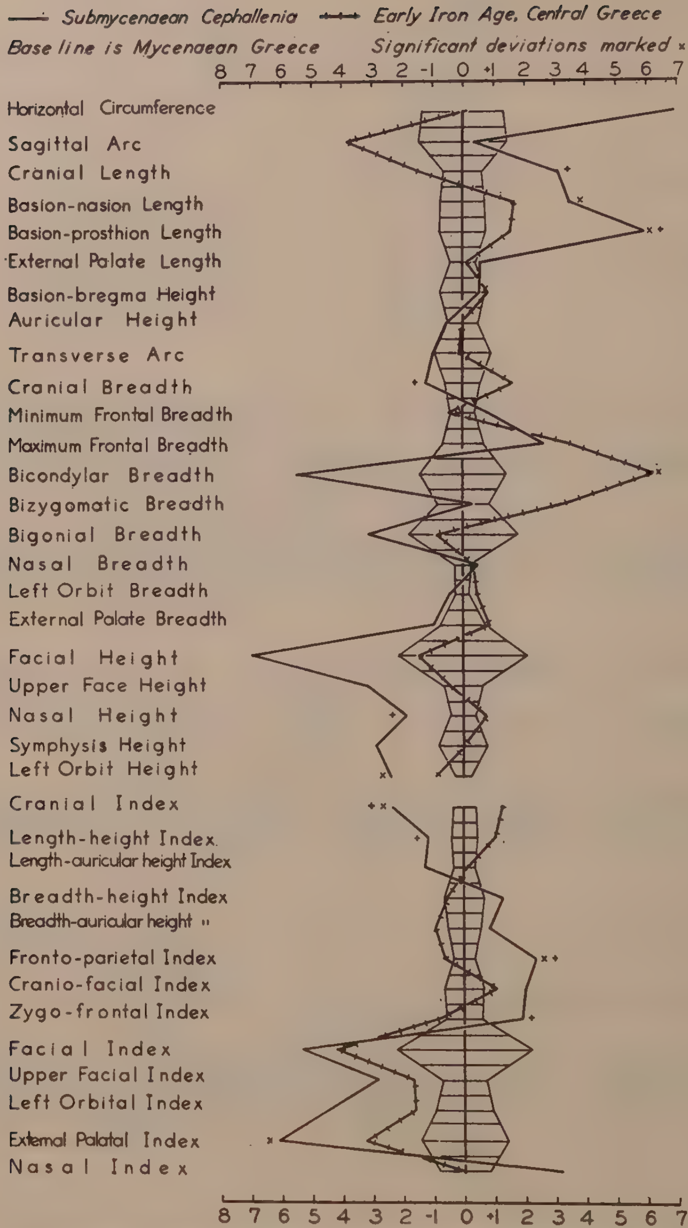


Fig. 1 Diagram of mean deviations of Submycenaean Cephallenia and of Early Iron Age Greece from the Mycenaean series of Isthmian Greece. The extent of the probable error of the Mycenaean series which forms the base line is indicated by a horizontally hatched area. Statistically significant differences (3 x p.e.) from the Mycenaean series are marked with an X; those of Cephallenia from the Early Iron Age with a plus sign.

though the Cephallenian averages are closer to Mycenean than to Early Iron Age.

These raw deviations may be listed as follows:

GROUPS	38 MEASUREMENTS	23 INDICES
Cephallenia vs. Mycenaean	1.90 mm.	2.79 index units
Cephallenia vs. Early Iron Age	2.25 mm.	2.23 index units
Early Iron Ave vs. Mycenaean	1.30 mm.	1.30 index units

The mean deviations of any Greek period group from the preceding period are 1.60 mm. and 1.81 index units. Much more valid are the directions of deviation of average measurements of the various groups compared, and the statistically significant differences which occur (figs. 1 and 2): raw deviations or modified deviations as used in the coefficient of racial likeness inevitably pile up correlated differences which may be common results of a single difference in gross size, for instance, or may be effects of a single gene complex.

Table 1 and figures 1 and 2 expound the metric peculiarities of the Cephallenians. Cephallenians show nine significant deviations, and five additional possibly significant deviations (2.50 x p.e.) from the Mycenaeans, and eleven significant with seven possibly significant deviations from the Early Iron Age. The Early Iron Age mainlanders only show two significant and one possibly significant difference from the Mycenaean Greeks. On the other hand Cephallenians show lower raw deviations and fewer significant deviations from Chalcolithic Sardinians than they do from the two mainland Greek series, or than the Sardinians show from Mycenaean Greeks (figs. 1 and 2).

Since the type distributions outlined above fail to reflect these sharp metric differences between Mycenaean Greeks and Cephallenians or Sardinians, a close examination of Cephallenian traits seems profitable. The average Cephallenian disharmonically combines a dolichocrane, low orthocrane, and metriocrane vault with relatively broad forehead, with a euryprosopic, hardly mesene, chaemerrhine, chaemeconch, and mesouranic face: so-called Cro-Magnon disharmony. In general the vault is large, coffin-shaped, angular and ill-filled, with

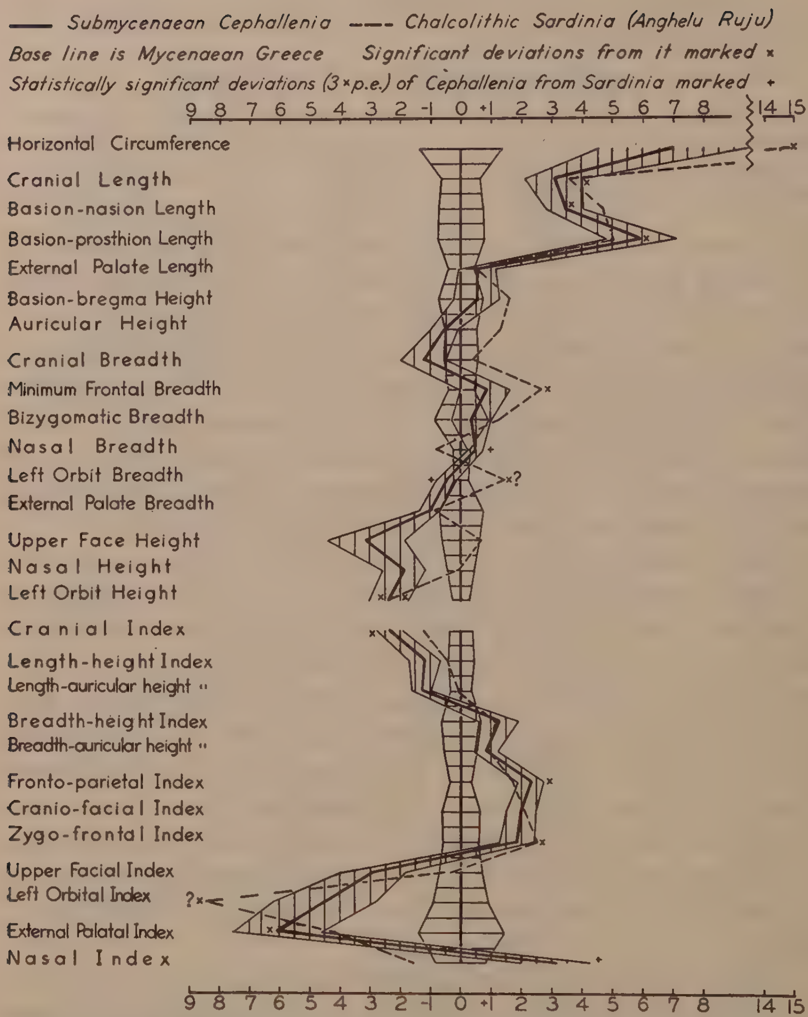


Fig. 2 Diagram of the mean deviations of Submycenaean Cephallenia and of Chalcolithic Sardinia from the Mycenaean series of Isthmian Greece. The area of the Mycenaean probable error is horizontally hatched, that of the Cephallenian probable error vertically hatched. Significant differences from the Mycenaean base line are marked with an X; those of Cephallenia from Sardinia with a plus sign. Correlated or "covering" measurements of the vault and face are grouped together to demonstrate the similarity in trend of Cephallenian and Sardinian away from the Mycenaean series.

long base and long and gabled parietal bones, short and somewhat broad frontal bone lacking much forehead slope, mildly flattened temporal region, lambdoid flattening, and thick tympanic plates. The squat face is marked by strikingly low and level orbits of rounded oblong shape and rather small size; by large but compressed and retreating cheekbones; by prognathism which affects mid-facial as well as mouth region of the face and even exceeds the Mycenaeans in the former; by a salient but coarse, broad-bridged, chaemerrhine, and concave-straight nose whose projection explains the contrast of mesognathous Cephallenian profile with concave Mycenaean profile; and by a relatively long, narrow, and elliptical palate linked with morphologically definite alveolar prognathism, an overbite, good teeth, and perhaps a narrow and unimpressive mandible.[14]

The average Cephallenian thus defined differs from the average Mycenaean in three general directions: (1) He has a larger skull and taller stature; explicable partly on the basis of more big-skulled Mixed Alpines in Cephallenia, with more of the Megalithic subtype of Basic White, and partly from environmental or other local causes. (2) He has tendencies toward relative narrowness and especially toward greater length clear in vault, palate, and perhaps jaw; these seem mainly the result of a much stronger component of the Megalithic subvariety of the Basic White type (Coon, '39, pp. 85, 146–147), a subvariety weakly represented among Mycenaean Basic White crania which furthermore often show a fullness explicable by Alpine mixture. (3) His face is strikingly shorter, broader-nosed, more variable, and more prognathous: these facial peculiarities seem to be expressions of insular and partially inbred recombinations of short faced Basic White, Alpine, and gracile Mediterranean traits which do not occur so frequently on the mainland. Thus in general the Cephallenians differ from Mycenaeans more in measurements and proportions than in morphology, and show much stronger

[14] Morphological observations as well as measurements on which this description is based have been listed in an earlier work by the writer (Angel, '42 a).

TABLE 2

Submycenaean Cephallenian females compared with Greeks and Sardinians, and Type A Greek males (Basic White).

CHARACTER	MYCENAEAN GREECE Mean	p.e.	N	CEPHALLENIA Mean	p.e.	N	EARLY IRON AGE Mean	p.e.	N	SARDINIA Mean	p.e.	N	TYPE A (MALES)[1] Mean	p.e.	N
Horizontal circumference	497.72	1.54	21	503.00	3.91	6	501.20	3.94	10	*511.37	2.05	19	+*525.73	1.33	45
Sagittal arc	362.50	1.67	17	362.84	3.12	6	360.94	3.18	9				+*381.24	1.30	35
Frontal arc	126.50	1.13	11	124.26	1.48	8	123.34	1.25	12				+*129.50	.76	32
Parietal arc	124.14	1.40	11	123.50	1.65	8	123.96	.99	15				128.96	.78	38
Occipital arc	118.50	2.02	5	115.08	.92	7	112.40	1.64	12				120.29	.88	27
Transverse arc	297.84	1.23	18	299.70	3.54	5	302.66	2.82	12				307.15	1.12	39
Cranial length	174.73	.82	26	176.82	1.24	11	176.87	.75	15	*179.35	.66	23	+*191.07	.49	56
Cranial breadth	135.92	.73	26	135.90	1.06	10	136.80	1.13	15	137.50	.55	22	139.54	.45	57
Basion-bregma height	128.06	.88	17	127.50	1.13	6	128.38	.91	13	129.50	1.12	14	133.19	.61	36
Auricular-vertex height	112.84	.59	25	110.86	.93	7	112.21	.97	14	115.68	.64	22	116.22	.46	50
Minimum frontal breadth	92.30	.51	23	92.87	.86	8	92.00	.82	13	94.96	.61	23	97.28	.38	43
Maximum frontal breadth	113.50	1.25	10	117.38	1.42	9	111.83	1.21	9				117.64	.69	28
Frontal angle	50.40	.48	15	51.00	.80	5	50.33	.58	12				50.00	.38	34
Basion-nasion length	94.00	.66	17	94.00	1.85	4	95.40	.85	10	99.43	1.15	7	+ 102.47	.55	32
Basion-prosthion length	90.36	.66	11	86.67	2.50	3	90.10	1.28	10	94.43	.95	7	+ 98.87	.91	16
Facial angle	82.55	.46	11	86.00	.48	3	*87.33	.76	12				86.37	.67	16
Midfacial angle	90.68	.44	11	94.50	.96	3	*94.50	.75	12				93.61	.54	18
Alveolar angle	62.50	1.23	11	65.17	.48	3	65.42	.77	13				66.90	1.33	15
Bizygomatic breadth	119.71	.83	14	121.00	1.56	3	124.71	1.38	7	*124.78	1.11	9	132.52	.76	21
Bigonial breadth	90.50		2	99.00		1	91.34	.97	12				102.78	1.20	7
Facial height	105.50		2	107.00		1	110.16	1.43	12				109.17	2.46	6
Upper face height	64.31	.73	13	63.33	.99	3	65.23	.60	13	65.60	.79	10	67.05	.88	19
Nasal height	47.23	.39	13	47.00	1.17	3	48.15	.48	13	48.70	.75	10	—*48.92	.48	22
Nasal breadth	23.00	.38	12	23.00	.39	3	22.45	.37	11	23.60	.34	10	24.95	.25	22
Nasalia angle	52.50	1.42	9	56.00	1.15	4	54.90	2.54	5				54.50	1.27	17
Upper nasalia breadth	11.25	.36	20	11.71	.55	7	13.25	.42	8				12.51	.22	39

Left orbit height	32.50	.30	12	33.67	.46	3	32.60	.29	10	*31.09	.41	11	32.24	.31	25
Right orbit height	32.38	.22	13	33.33	.60	3	32.22	.46	9				32.19	.37	21
Left orbit breadth	37.00	.46	11	37.00	1.07	3	37.50	.27	10	*40.00	.32	11	38.65	.17	23
Right orbit breadth	37.38	.29	13	38.00	.78	3	38.11	.33	9				39.33	.23	21
Interorbital breadth	20.40	.33	20	21.00	.37	5	20.71	.38	7				22.03	.21	35
Biorbital breadth	93.56	.56	16	93.50	1.25	4	93.11	.52	9				+*99.85	.43	26
External palate length	51.09	.48	11	48.67	1.13	3	49.58	.57	12	51.86	.60	7	53.67	.29	21
External palate breadth	58.33	.47	9	58.33	1.25	3	59.10	.55	10	57.71	.77	7	63.77	.58	22
Symphysis height jaw	29.00		2	25.50		2	29.69	.81	13				32.99	.74	9
Condylo-symphys. length	94.50		2	94		1	97.84	1.34	12				102.50	2.77	4
Bicondylar breadth	118.50		2	114		1	116.34	1.44	12				123.13	2.00	3
Mandibular angle	127.16		3	126		1	125.78	1.02	14				124.50	1.83	7
Min. br. ascending ramus	26.67		3	26		1	30.86	.66	14				31.87	.36	8
Cranial index	78.31	.56	26	76.90	.84	10	77.57	.56	14	76.86	.36	22	−*73.23	.26	55
Length-height index	73.62	.48	17	72.00	.97	6	72.67	.52	12	72.43	.78	14	−*69.81	.34	36
Length-auricular height	64.04	.36	24	62.36	.40	7	63.65	.49	13	64.55	.50	21	−*60.67	.28	48
Breadth-height index	95.09	.85	17	93.67	1.31	6	94.92	.91	12	93.79	.97	14	95.99	.53	35
Breadth-auricular height	82.38	.58	24	81.79	.75	7	81.88	.63	13	84.20	.53	20	83.60	.33	49
Fronto-parietal index	68.07	.50	23	68.00	.60	6	67.65	.59	13	69.05	.51	22	+ 69.87	.35	43
Cranio-facial index	91.29	.79	14	90.83	1.76	3	89.60	.93	10	91.00	.66	8	+*94.35	.65	20
Zygo-frontal index	74.93	.55	14	74.17		3	75.06	.84	9	76.40	1.03	9	73.39	.57	19
Fronto-gonial index	99.00		2	111.50		1	98.83	.85	9				105.90	2.92	5
Zygo-gonial index	77.50	.67	2	81.50		1	73.61	1.12	9				77.50	1.45	5
Facial index	89.00		2	88.50		1	91.10	.97	10				83.90	2.36	5
Upper Facial index	53.14	.83	11	52.50		3	53.40	.72	10	53.17	.62	9	51.03	.78	15
Nasal index	49.25	.93	12	49.17	.46	3	46.77	.90	11	48.90	.87	10	+ 51.55	.80	20
Left orbital index	89.20	1.23	10	91.17	2.24	3	87.00	1.07	10	77.59	1.19	11	83.54	.85	22
External palatal index	115.00	1.50	8	120.17	.46	3	118.28	1.76	9	111.21		7	119.30	1.19	20

[1] Angel, '42 a. Type A is the east Mediterranean equivalent of the Atlanto-Mediterranean type. Significant differences from the total series of ancient Greek males are marked.

Megalithic tendencies (cf. plate 1), more mixed Alpine tendencies (cf. plate 4), more peculiar combinations of Basic White with Mediterranean and perhaps Alpine facial traits (cf. plates 1–4). Iranian traits, clearest in nasal saliency, are masked by Basic White and Mediterranean with which they are thoroughly blended (cf. plate 3) as also among Mycenaeans. But the Alpine type proper, in contrast to the excess of Mixed Alpines, is less entrenched than on the mainland (cf. plate 4). Thus the Cephallenians carry to a greater extreme Basic White trends dominant among the more thoroughly blended Mycenaeans, and would show a much more definite type deviation from the Mycenaeans if finer type subdivisions could be used, based on a larger total mass of Greek crania.

In all these respects the Cephallenians approach closely or coincide with the much earlier Sardinians, except for one statistically significant difference: the Sardinians have absolutely very narrow noses and an almost leptorrhine nasal index. It is probable that the Sardinians really do have broader orbits, though the uncertainty of comparability of Sergi's orbit breadth makes this tentative. And the Sardinians appear to have somewhat bigger and relatively broader crania, and higher faces. The narrow nose and high face among Sardinians can be shown to be a result of a greater proportion of pure Megalithic type and possibly ellipsoid Iranian crania as opposed to local versions of Basic White in Cephallenia,[15] and comparison of selected Alpine crania from the two islands shows a much stronger and more distinct Alpine element in Sardinia than in Cephallenia. This Sardinian Alpine has a strikingly low vault and low face, with cranial index of 82.5, breadth auricular height index of 78.2 and nasal index of 49.7. And while it links plausibly with the low-vaulted Eastern Alpine which occurs in the Aegean, Anatolia, Cyprus, and probably Crete and Mesopotamia [16] it is far from a Bell-

[15] Comparison of the averages of selected Type A skulls from the two islands exaggerates the facial contrast.

[16] Well described so far only for Hittite Empire crania (Krogman, '37) but occurs in Troy IV–V and in Greece and Aegean (personal observation), in Crete (Duckworth, '13, appendix A), in Cyprus, (Fürst, '33), and in Mesopotamia (Penniman, '34).

CHARACTER	Mean Sigmas[1]		MALES MYCENAEAN σ	V	CEPHALLENIA σ	V	EARLY IRON σ	V	SARDINIA σ	V	FEMALES MYC. σ	CEPH. σ	E. I. σ	SARD. σ
Horizontal circumference	14.14	24	11.37	2.19	16.75	*3.19	14.51	2.79	14.30	2.68	10.47	(14.19)	(18.45)	13.22
Sagittal arc	12.71	24	12.08	3.20	14.74	3.91	10.66	2.85			10.18	(11.32)	(14.16)	
Frontal arc	6.01	15	3.68	2.86	6.90	*5.45	4.82	3.74			(5.58)	(6.22)	(6.40)	
Parietal arc	7.65	15	6.48	5.01	9.72	*7.51	7.10	5.60			(6.88)	(6.94)	5.68	
Occipital arc	7.46	16	(5.62	4.71)	7.30	6.09	5.34	4.54			(6.70)	(3.60)	(8.42)	
Transverse arc	10.02	12	7.58	2.45	9.48	3.08	9.50	3.08			7.74	(11.72)	(14.50)	
Cranial length	6.00	26	5.72	3.09	7.02	3.72	5.33	2.90	7.91	4.19	6.21	(6.08)	4.30	4.67
Cranial breadth	5.03	26	5.31	3.79	5.80	4.17	6.35	4.48	5.20	3.70	5.51	(4.95)	6.50	3.80
Basion-bregma height	5.12	20	5.56	4.18	4.81	3.60	5.50	4.11	(4.99	3.71)	5.37	(4.09)	(4.89)	(6.00)
Auricular-vertex height	4.24	15	4.44	3.83	3.50	3.03	4.55	3.93	4.46	3.80	4.38	(3.64)	(5.40)	4.48
Minimum frontal breadth	4.32	24	3.73	3.89	5.59	*5.79	4.52	4.74	3.40	3.46	3.62	(3.60)	(4.36)	4.31
Basion-nasion length	4.22	22	5.47	5.54	3.51	3.43	4.66	4.64	(5.63	5.44)	4.03	...	(3.98)	(4.16)
Basion-prosthion length	4.88	19	4.39	4.71	5.07	5.11	3.99	4.21	(6.13	6.24)	(3.24)	...	(5.98)	(3.46)
Facial angle	3.22	5	2.68		4.37		3.90				(2.26)	...	(3.89)	
Bizygomatic breadth	5.10	22	5.76	4.46	(3.60	*2.78)	6.89	5.20	(4.00	3.07)	(4.62)	...	(5.41)	(4.66)
Bigonial breadth	6.62	10	(6.54	6.47)	...	...	5.36	5.35			...	...	(5.00)	
Facial height	6.33	6	(7.74	6.74)	...	...	6.40	5.65			...	...	(7.32)	
Upper face height	4.28	23	3.76	5.50	(6.37	*9.76)	4.29	6.31	(3.84	5.56)	(3.90)	...	(3.20)	(3.50)
Nasal height	3.03	16	2.82	5.70	(3.84	8.06)	2.91	5.79	(3.29	6.67)	(2.09)	...	(2.55)	(3.34)
Nasal breadth	1.81	25	1.78	7.42	(1.51	6.16)	1.82	7.47	(1.23	5.31)	(1.95)	...	(1.82)	(1.51)
Left orbit height	1.99	12	1.86	5.62	(3.22	10.48)	2.19	6.81	(1.90	6.20)	(1.52)	...	(1.36)	(1.92)
Left orbit breadth	1.84	6	1.55	4.01	(1.62	4.24)	1.88	4.81	(1.81	4.53)	(2.28)	...	(1.28)	(1.51)
External palate length	2.93	8	2.60	4.90	(3.18	5.93)	3.01	5.66	(4.96	9.24)	(2.34)	...	(2.94)	(2.19)
External palate breadth	3.19	7	4.22	6.69	(1.70	*2.74)	(2.93	4.58)	(3.63	5.84)	(2.07)	...	(2.60)	(2.81)
Symphysis height jaw	2.84	12	(3.75	11.50)	...	...	3.55	10.89			...	...	(4.31)	
Condylo-symphys. length	5.17	9	...	...	...	...	(6.70	6.46)			...	...	(6.40)	
Bicondylar breadth	5.58	9	...	...	...	...	(4.04	3.17)			...	...	(7.40)	
Mandibular angle	6.28	8	(2.18)	...	...		6.28				...	...	(5.64)	
Min. br. ascending ramus	2.71	11	(1.32	4.16)	...	...	2.19	6.76			...	...	(3.68)	
Cranial index	3.22	23	3.45		3.24		3.71		5.29		4.22	(3.93)	(3.12)	2.48
Length-height index	3.05	19	3.31		3.19		2.81		(2.54)		2.91	(3.51)	(2.66)	(4.18)
Lenght-auricular height			3.02		2.27		2.70		2.52		2.63	(1.57)	(2.64)	3.39
Breadth-height index	4.61	7	4.91		4.16		5.79		(6.25)		5.21	(4.75)	(4.67)	(5.18)
Breadth-auricular height			4.59		*2.78		4.18		4.90		4.21	(2.93)	(3.36)	3.54
Fronto-parietal index	3.23	4	3.10		2.89		3.84		3.48		3.52	(2.18)	(3.14)	3.54
Cranio-facial index			4.25		(*2.68)		3.67		(5.36)		(4.39)	...	(4.35)	(2.57)
Zygo-frontal index			3.62		(3.02)		3.48		(2.32)		(3.03)	...	(3.72)	(4.30)
Upper facial index	3.30	8	4.16		(5.02)		3.81		(1.73)		(4.06)	...	(3.58)	(2.60)
Nasal index	4.49	15	5.37		(6.03)		*3.43		(3.53)		(4.79)	...	(4.44)	(3.87)
Left orbital index	5.33	5	5.77		(8.36)		5.31		(5.81)		(5.78)	...	(5.04)	(5.58)
External palatal index	6.61	7	(7.81)		(6.95)		(8.59)		(8.55)		(6.30)	...	(7.83)	

[1] Howells, '41, pp. 146–147

Beaker or Cypriote Dinaric type, approaches a European Alpine, and is fully comparable with the Greek Alpine type which includes both European and "Eastern" tendencies. Cephallenians thus approximate Chalcolithic Sardinians [17] and show also insular traits in their nasal coarseness and width. This is clearly shown in figure 2, where the grouping of correlated ("covering") measurements permits easy analysis of trend of Cephallenians and Sardinians away from Mycenaeans, represented by the base line. In order to avoid graphic exaggeration of insignificant differences, an area extending 1 x p.e. on both sides of the points representing each measurement is hatched vertically for the Cephallenians, horizontally for the Mycenaeans.[18] Statistically significant deviations from the Mycenaeans are marked with an X, and significant deviations of Cephallenians from the Sardinians with a plus sign.

Comparison of Cephallenians with Minoan Cretans shows the latter considerably smaller, plausibly because of a higher percentage of Classic Mediterraneans in Crete.[19] But the similarity between Cephallenians and Minoans in skull proportions is close, and the virtual identity of short face, low orbits, and relatively broad nose in the two groups is striking.[20] It is clear that in those features in which Cephallenians differ from both Mycenaeans and from Sardinians they resemble Minoan Cretans.[21]

The Cephallenian female series is too small to be reliable. But it differs from Mycenaean Greeks in the same direction as do the males but by a smaller amount. Like the males, the

[17] Cephallenians appear to be even closer to Chalcolithic Siculans, deviating chiefly in their lower noses and narrower jowls.

[18] It must be remembered that this does not in any way compensate for inaccuracies of average measurements resulting from inadequate samples.

[19] A guess bolstered by the close approximation to Minoan Cretans of the composite made by averaging the means of the Greek Basic White and Mediterranean types.

[20] Unfortunately no statistical or morphological confirmation of these comparisons is possible on the basis of published data.

[21] Cephallenians differ from Early Dynastic and earlier South Mesopotamians and from Amratian period Egyptians chiefly in lack of the high cranial vaults and faces found among the latter.

Cephallenian females approach Sardinians more closely than Mycenaeans in shape, but the Sardinian female series is much larger in gross size, a finding which perhaps reflects errors in sexing, though the Sardinians as a whole are larger skulled than any of the Greek series.

Pathological changes are interesting. In addition to medium arthritic exostoses on lumbar vertebrae, gluteal insertions of femora, and plantar surfaces of calcanea of 1 Ce, there occurs a compound tibial fracture from the Metaxata chamber tomb [22] assigned to skulls 13–17 Ce, and a plethora of skull injuries. Except for a depression to the right of the sagittal suture in the female 24 Ce, these injuries are limited to males. 1 Ce shows a button osteoma. 18 Ce shows a sharp depression on left parietal just above obelion. 29 Ce shows a thrust wound high up on left frontal of spear or arrow which might have traveled horizontally to man's head and at an angle of about 45 degrees to the left of his line of vision. 32 Ce's thrust wound is in a corresponding position on the right side, and 31 Ce's is on the left frontal, but fainter than in 29 Ce. 33 Ce's healed left zygoma is broken just in front of its root, and 37 Ce shows a groove along the left zygoma which also destroys the supramastoid crest. 23 Ce has a successful trephination whose roughly oblong gap measures 15 × 21 mm., apparently opened by the scraping method, since the opening is surrounded by a well-healed bevelled scarp about 8 mm. wide (cf. plate 4). That this may be the result of treatment for an arrow wound is suggested by a perforation in the left parietal of 36 Ce, 30 mm. above asterion, and showing bevelled edges as if a weapon had been gouged out either just before or after death (cf. plate 4).[23] Thus head injuries occur in at least 32.2% of male

[22] Left tibia shows a compound fracture at junction of lower and middle thirds, healed with good position, but with lower fragment displaced backward and medially through pull of gastrocnemius, and ossification of the interosseous membrane to form a bony bridge to the fibula possibly as an indirect result of a flesh wound from behind suggested by a slight depression.

[23] Other holes in this skull might have been made after burial, but this perforation's markings look like cuts on green bone. The other skull pathologies can be made out with a magnifying glass from the various plates.

Cephallenians and in 47.1% of the male skulls from Mazarakata. If more skeletons were available a still larger percentage of body wounds might be demonstrated.

MORE OR LESS OBJECTIVE CONCLUSIONS

1. Ancient Greeks as a whole, including the Submycenaean inhabitants of Cephallenia, are unusually heterogeneous.

2. This high variability, about 7% above normal, allows distinguishing of six arbitrary morphological types to express artificially genetic composites possible in Greece.

3. The rugged and large Basic White Type, an East Mediterranean relative of the Atlanto-Mediterranean, is the key among Cephallenians, Mycenaean Greeks, Chalcolithic Sardinians, (and perhaps among Minoan Cretans). Contrast of this and the Classic Mediterranean type with Alpine and Mixed Alpine minorities is typical of these groups, the Mycenaeans showing a more closely blended, less variable population than the others. These groups thus contrast with the Alpine-dominated Greek mainlanders of the Early Iron Age.

4. The linear ''Megalithic'' component of Basic White is very much stronger among Cephallenians (and Sardinians) than among Mycenaeans, and accounts for the slight listed type distinction between them in contrast to definite metric divergencies.

5. Cephallenians in general combine long and angular braincases with short, low-orbitted, coarse- and broad-nosed, and slightly prognathous faces.

6. Where they diverge from Mycenaeans, Cephallenians approach closely to Sardinians (and to the short-faced Siculans) except for short face with broad nose in which they approximate Minoans.

7. These similarities suggest strongly that Cephallenians represent a third millennium B.C. Mediterranean island population surviving into the Iron Age with slight local specialization and little admixture.

SPECULATION AND INFERENCE

From a genetic standpoint two things are notable about the Cephallenians. One is their definite variability in size but not in proportions, and the other their peculiarly low faces.

I have already noted that the excessive variability of diameters and arcs over that of indices may plausibly reflect relatively high percentages of types A and B (38% and 31% respectively) among the Cephallenians, since Basic White skulls as a whole are considerably larger and more rugged than Classic Mediterraneans.[24] But since the types are purely artificial in derivation types A and B respectively may represent the rugged and gracile halves of a broader "Mediterranean Race".

Dr. W. D. Wallis ('38) has shown that in most series of skulls anatomic lag occurs: in measures which are positively correlated each tends to lag upon the other, often in different degree, so that they do not both increase or decrease in size at the same relative rate.[25] As far as the skull is concerned this seems to depend on mass or cortical surface of brain relative to total body size (cf. Huxley, '32, p. 229), so that small crania are more brachycrane than large ones. And though a smaller area of bone-forming membrane or reduced growth potential of independent growth centres of skull bones may lead to a more globular and bachymorph brain independent of general body and head size, this would if anything increase the degree of anatomic lag in skull length and breadth.

This principle is illustrated by Cephallenians and by types A and B. Ten Cephallenians with large skulls (circumference over 525 mm.) combine cranial index of 72.10 with length of 195.70, in contrast to cranial index of 75.28 and length of 182.91 for 11 small male skulls (circumference under 525 mm.).

[24] Contrast plates 1 and 3. These photographs should show that the Classic Mediterranean type does not include any wrongly sexed females.

[25] This phenomenon can be taken as an example of heterogony in growth, is by implication partly a function of simple individual difference in gross size, and is obvious in adult populations of one sex or between sex or race groups as well as during growth.

Thus short and small crania have a cranial index 3.18% higher than long crania. This is an insignificantly smaller increase than expected on the basis of caphalic index correlated with length among German males,[26] but considering the contrast of high variability and multimodality in Cephallenian length and breadth diameters and normal distribution of the stable Cranial Index it is possible that lag of breadth on length is less marked than usual among Cephallenians as a whole. From lessened lag one might infer that types A and B must show some morphological and metric distinctiveness beyond the differences expected from size difference alone.[27] In this case their preponderance among Cephallenians can account for the observed contrast in variability between diameters in general and indices. Type B is not sufficiently mesocrane to be a stunted or young version of type A, or to raise the variability of indices involving transverse and sagittal diameters. And in any case size difference may have genetic as well as environmental determinants.

It seems probable, therefore, that inherited differences in form help to produce anatomic lag. The addition of Alpine and Mixed Alpine groups to Basic White and Mediterranean seems to increase lag among Cephallenians. And R. S. Wallis has shown ('34, p. 318) that correlation between skull length and breadth varies widely from 0 to .6, that the correlation is consistently greater in selected extreme dolichomorph or brachymorph groups than in the whole group, and that a low correlation is reflected in a variable cranial index. The Sardinians appear to show this effect, with much clearer segregation of Alpine and long-headed groups than among Cephallenians.

[26] A change of 3.52% would be expected according to the formula cephalic index of males = 134.62 — .2751 head length. See Wallis, '38, p. 94.

[27] Ten type A Cephallenians combine a cranial index of 72.0 with a length of 193.2 mm., in contrast to six type B skulls with values of 73.6 and 182 mm. respectively. Corresponding values for the total series of males are: Type A 73.2 and 191.1 mm., type B 74.6 and 181.8 mm. Cranial index differences are well below those to be expected in an unselected population and Anatomic lag is less though still present.

From this involved discussion the following tentative inferences are possible. First, that contrast in metric and indicial variability reflects lessening of anatomic lag in the Cephallenian population. Second, that this results as much from weak expression of an Alpine type contrasting with the Basic White in form as from strong expression of a Classic Mediterranean type which contrasts chiefly in size. Third, that at least symbolic reality of types is indicated by their effect on degree of expression of anatomic lag. Fourth that it is impossible to tell to what extent size contrast, which helps to produce both lag and high size variability, is a result of environment or heredity. This brings out the problem of isolated population: if Cephallenians show smooth blending of contrasting forms why should a separation of contrasting size groups mark them?

A similar unanswerable question is raised by the Cephallenian face. Examination of 14 Ce, in plate 2, lower left, shows an excessive lowness of face in all segments with no indication of any pathological cause. Several other crania show marked lowness of the upper portion of the face. And it is entirely possible that through social or other selection a genetic trend toward facial lowness has become emphasized, and is shown in 14 Ce in "homozygous" form. This trend is more feebly shown by ancient Minoans, Sicilians, Greeks, and perhaps Trojans in contrast to surrounding or modern populations. And while this is more typical of Basic White and Alpine types in Greece than of the others, the Megalithic variety of Basic White has normally a linear face, as in 30 Ce, in Greece as elsewhere. Cephallenian prognathism seems to be linked with space limitations of the short face, and thus to present a parallel to negroid face projection from which it is clearly separated by the salient Cephallenian nose and the orbit form. It may also be a function of relative inbreeding of a small number of island families: as in Mycenaean chamber tombs and the Geometric cemetery in the Athenian Agora a certain degree of family resemblance is perceptible subjectively among skulls from a single tomb.

Three problems emerge from these random inferences: (1) How far can size changes of a purely environmental origin change form?[28] (2) How far is the paedomorphy which in different guise marks both gracile Mediterranean and some Alpine physical types a simple size change? (3) Is there a single recessive gene complex which controls face height through slowing down the rate of vertical growth? And if so, what is its racial distribution?

The following racial history can be proposed for the Ionian Islands in general and Cephallenia in particular.

First settlers arriving with a Neolithic culture probably about the end of the fourth millennium B.C. came from the adjacent coast of West Greece, and included both narrow-skulled gracile Mediterraneans[29] and broad-vaulted and short-faced Alpines or Mixed Alpines,[30] probably much the same in composition as the groups of Near Eastern colonisers which settled the Greek mainland, and conceivably drawing a portion of Alpine strains from wandering Mesolithic survivors in the adjacent Illyrian mountains. A second set of immigrants in Early Bronze times (before the end of the third millennium) consisted of rugged Basic White types including the Megalithic linear extreme and a low-headed and low-faced variant.[31] A certain percentage of gracile Mediterraneans and probably a small minority of Near Eastern Alpines may have been included in this immigration which is assumed to be one phase of the westward spread of the Megalithic rock-cut collective tomb culture from an unknown East Mediterranean source. My own guess of the Chalcolithic North Palestine coast as a

[28] Study of changes in skull measurements in the Isthmus region of Greece from Neolithic to modern times correlated with dietary changes suggest that proportions are little affected by the environment alone, but give no means of accurate measurement of the degree of effect (Angel, '42 a).

[29] Compare two crania from a Neolithic cave on the coast west of Astakos in Acarnania, and examined by me in the Athens Anthropological Museum (Benton, '31–'32).

[30] Compare the brachycrane male (?) from the Neolithic site of Choirospilia in southern Leukas (Velde, '12).

[31] Photographs in Velde ('12).

likely origin (Vallois, '37) is no more probable than a Cypriote, Cretan, or southern Cycladic direct source, with a possible southern Anatolian origin in the background.[32] As C. S. Coon ('39) has shown, the important point is that maritime spreads westward through the Mediterranean appear to have involved the rugged Megalithic or Atlanto-Mediterranean type much more than its gracile relative. The population of Bronze Age Ionian Islands may well be indicative of an Adriatic movement involving chiefly this same type (Coon, '39, p. 147, 155): the three known pre-Iron Age crania from Carniola (Vram, '03) do not preclude this assumption, which is supported by some of the Iron Age skulls of Piceni from Novilara (Sergi, '07 a.).

The "Iranian" nasal saliency seen in 1 Ce, 26 Ce, and some other Cephallenians may be either a trait brought by the migration just outlined or by a minor addition of Greek-speakers about the middle of the second millennium. A number of Mycenaean mainlanders could have been absorbed by the Cephallenian population also, especially if the Bronze Age people of Elis and Achaea were longer-headed than those of Attica and Argolis. And finally the occurrence of a few apparently exotic mesocrane and brachycrane skulls among the Cephallenians[33] is a hint of recent intrusion from the adjacent mainland mountains comparable to that which brought the Dorians and other ethnic groups into Isthmian Greece (cf. Angel, '42 b, p. 219). Later data from the island are lacking. My subjective impressions of modern Ionian islanders may be mentioned, though I was unable to measure enough living Greeks for any metric comparisons of this population. Long-headed Atlanto-Mediterraneans still are the striking component of the Cephallenian population, but various Alpine combinations including certain Dinaroid types are probably as frequent minorities now as the gracile Mediterranean type.

[32] In his discussion of the crania of children from Chalcolithic Tarsus Ehrich ('40, p. 91) points out the importance of a version of the Mesopotamian Eurafrican-Atlanto-Mediterranean type in southern Anatolia.

[33] Especially from the site of Mavrata.

The head injuries suffered by over 30% of Submycenaean Cephallenians demand an ethnological explanation. The period of 1200 B.C. is notable for three things: degeneration of Mycenaean civilization, the Trojan War, and incipient use of iron in Greece. There are therefore three possible fights in which these injuries could have been inflicted: a struggle with some West Greek invaders from the mainland mountains, the fighting before Troy whither the Cephallenians sent a division of warriors, or fighting local Adriatic pirates. The last two of these inferences seem equally likely. And two facts are of major importance. First, that iron seems to have been worked extensively first in eastern Anatolia or in Transcaucasia. Second that the fibula appears to have spread from the Aegean to North Italy and Central Europe by an Adriatic sea route. Both iron daggers (in Argostoli museum) and serpentine fibulae (Myres, '30, p. 429) occur in Cephallenian tombs, and the following suggestion seems possible. If a definite Adriatic (Amber) sea trade route and a vaguer Black Sea trade route existed in Mycenaean times, it seems possible that the Trojan War may have had an economic motive: to gain control of sea-borne supplies of iron from the east end of the Black Sea. At the same time exploitation of local iron supplies in the Adriatic is suggested by Homer's references to the piratical Taphians as traders in iron ore to be smelted in Temesse [34] as well as in bronze. Mycenaean helmets were by no means solid (Seymour, '08, pp. 661–663), and if iron weapons were even beginning to be used at this time their effect on a leather, bone-covered, or even bronze-plated helmet might well account for the injuries to the left side of Cephallenian heads. It seems inevitable to link this series of injuries, therefore, with the introduction of iron into the Aegean and Greece, and its gradual maritime spread together with the safety pin up the Adriatic to North Italy and Central Europe.

[34] Odyssey, I, 184.

CONCLUSIONS FROM SPECULATION

1. Relatively inbred island populations in periods of piracy and disturbed isolation will show an uneven combination of variability and stability in race rather than any prescribed "pure race".

2. The maritime spread through the Mediterranean of both linear and short-faced variants of the Megalithic or Atlanto-Mediterranean type (here called Basic White in its East Mediterranean range), together with Mediterranean and Alpine minorities, may be a significant example of selection when we know the population from which these seafarers were drawn.

3. Though a useful addition to comparison of average measurements, the types used here are too clumsy to express all differences and similarities which a keen contemporary observer of ancient Cephallenians might have noted. Flexibility might come both from a greater number of types and from use of morphological units made up of frequently linked characters.

4. Studies in Physical Anthropology cannot omit the historical and social background of the people or skeletons examined.

LITERATURE CITED

ANGEL, J. L. 1942 a A preliminary study of the relations of race to culture, based on Ancient Greek skeletal material. Ph.D. Thesis, Widener Library, Harvard University.

——— 1942 b Classical Olynthians, Appendix on skeletal material in D. M. Robinson "Excavations at Olynthus, Part XI, Necrolynthia," Baltimore, pp. 211–240.

——— 1943 Three auricular heights. Anthrop. Briefs, No. 4.

BENTON, S. 1931–'32 The Ionian Islands. British School Annual, vol. 32, pp. 213–246.

BRUNI, E. 1924 Gli omeri eneolitici di Anghelu Ruju. Riv. di Antrop. Roma, vol. 24, pp. 235–250.

COON, C. S. 1939 The races of Europe. New York.

DERRY, D. E. 1927 A study of the crania from the Oasis of Siwah. Harvard African Studies, vol. 8. Varia Africana 4, pp. 201–222.

DUCKWORTH, W. L. H. 1913 Archeological and ethnological researches in Crete. Brit. Assn. Adv. Sci., 82nd meeting, Dundee, 1912, pp. 224–268.

EHRICH, R. W. 1940 Preliminary notes on Tarsus crania. Am. J. Archeol., vol. 44, pp. 87–92.

FÜRST, C. M. 1933 Zur Kenntnis der Anthropologie der prähistorischen Bevölkerung der Insel Cypern. Lunds Univ. Årsskrift, N. F. Avd. 2, vol. 29, Nr. 6.

GIUFFRIDA-RUGGERI, V. 1901 Materiale paletnologico di una caverna naturale di Isnello presso Cefalù in Sicilia. Atti Soc. Rom. Antrop., vol. 8, pp. 337–363.

——— 1905 Terzo contributo all'Antropologia fisica dei Siculi eneolitici. Atti Soc. Rom. Antrop., vol. 9, pp. 56–103.

HOWELLS, W. W. 1941 The Early Christian Irish: the skeletons at Gallen Priory. Proc. Royal Irish Acad., vol. 46, Section C, no. 3, Dublin.

HRDLIČKA, A. 1938 Skeletal Remains, Appendix in P. L. O. Guy, and R. M. Engberg, Megiddo Tombs. Orient. Inst. Publ., vol. 33, pp. 192–208.

HUXLEY, J. S. 1932 Problems of Relative Growth. New York.

KROGMAN, W. M. 1937 Cranial types from Alişar Hüyük and their relations to other racial types, ancient and modern, of Europe and Western Asia, Appendix in H. H. von der Osten, The Alishar Hüyük, Seasons of 1930–'32, Part III, Orient. Inst. Publ., vol. 30, pp. 213–293. Chicago.

LUSCHAN, F. VON 1913 Beitrag zur Anthropologie von Kreta. Zeitschr. f. Ethnol., vol. 45, pp. 320–343.

MARTIN, R. 1928 Lehrbuch der Anthropologie. Jena.

MORANT, G. M. 1928 A preliminary classification of European races. Biometrika, vol. 20 B, pp. 301–375.

MYRES, J. L. 1930 Who were the Greeks? Berkeley.

PENNIMAN, T. K. 1934 A note on the inhabitants of Kish before the great flood. Appendix in S. Langdon and L. Ch. Watelin, Excavations at Kish, 1925–'30, vol. 4, pp. 65–72.

SERGI, G. 1907 Crani antichi della Sardegna. Atti Soc. Rom. Antrop., vol. 13, pp. 13–23.

——— 1907 a I sepolcreti di Novilara, Atti Soc. Rom. Antrop., vol. 13, pp. 129–142.

SEYMOUR, T. D. 1908 Life in the Homeric Age. New York.

SHAPIRO, H. L. 1929 Contributions to the Craniology of Central Europe, I., Crania from Greifenberg in Carinthia. Anthrop. Papers Am. Mus. Nat. Hist., vol. 31, Part I, pp. 3–120.

VALLOIS, H. V. 1937 Note sur les ossements humains de la nécropole énéolithique de Byblos. Bull. Mus. Beyrouth, vol. 1, pp. 23–34.

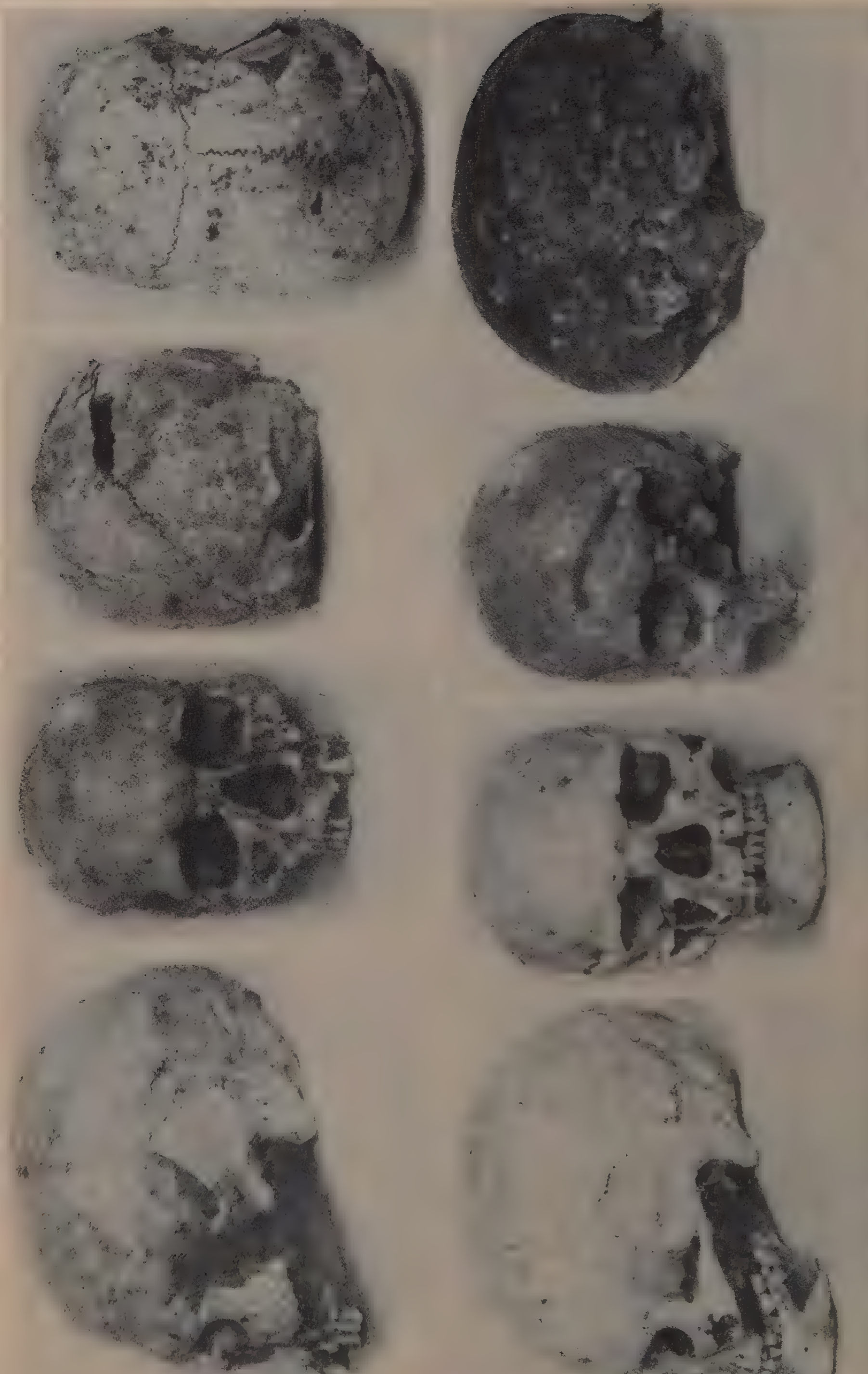
VELDE, G. 1912 Anthropologische Untersuchungen und Grabung in einer Höhle der jüngeren Steinzeit auf Leukas. Zeitschr. f. Ethnol., vol. 44, pp. 845–865.

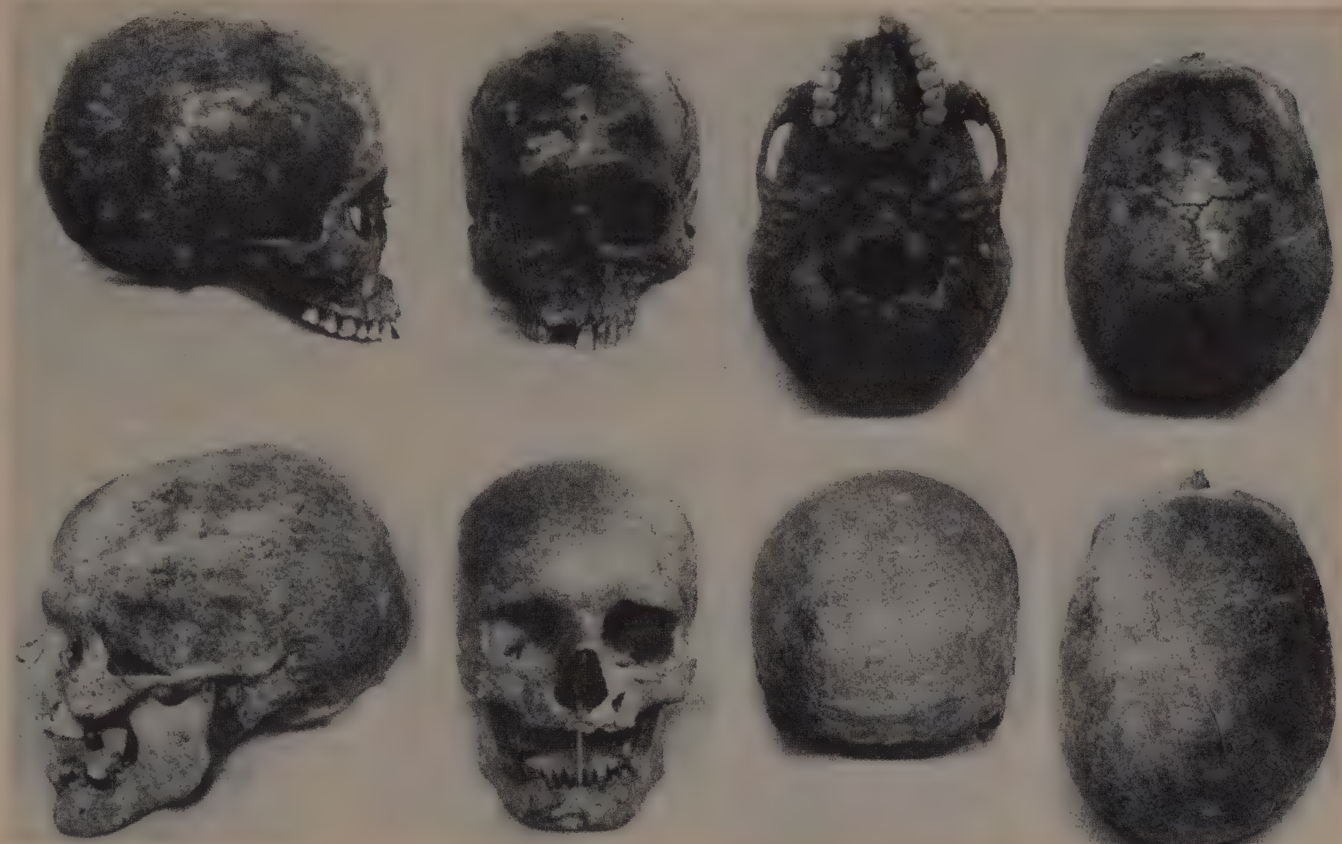
VRAM, U. C. 1903 Crani della Carniola. Atti Soc. Rom. Antrop., vol. 9, pp. 151–158.

WALLIS, R. S. 1934 Cranial relationships and correlations. Human Biol., vol. 6, pp. 308–323.

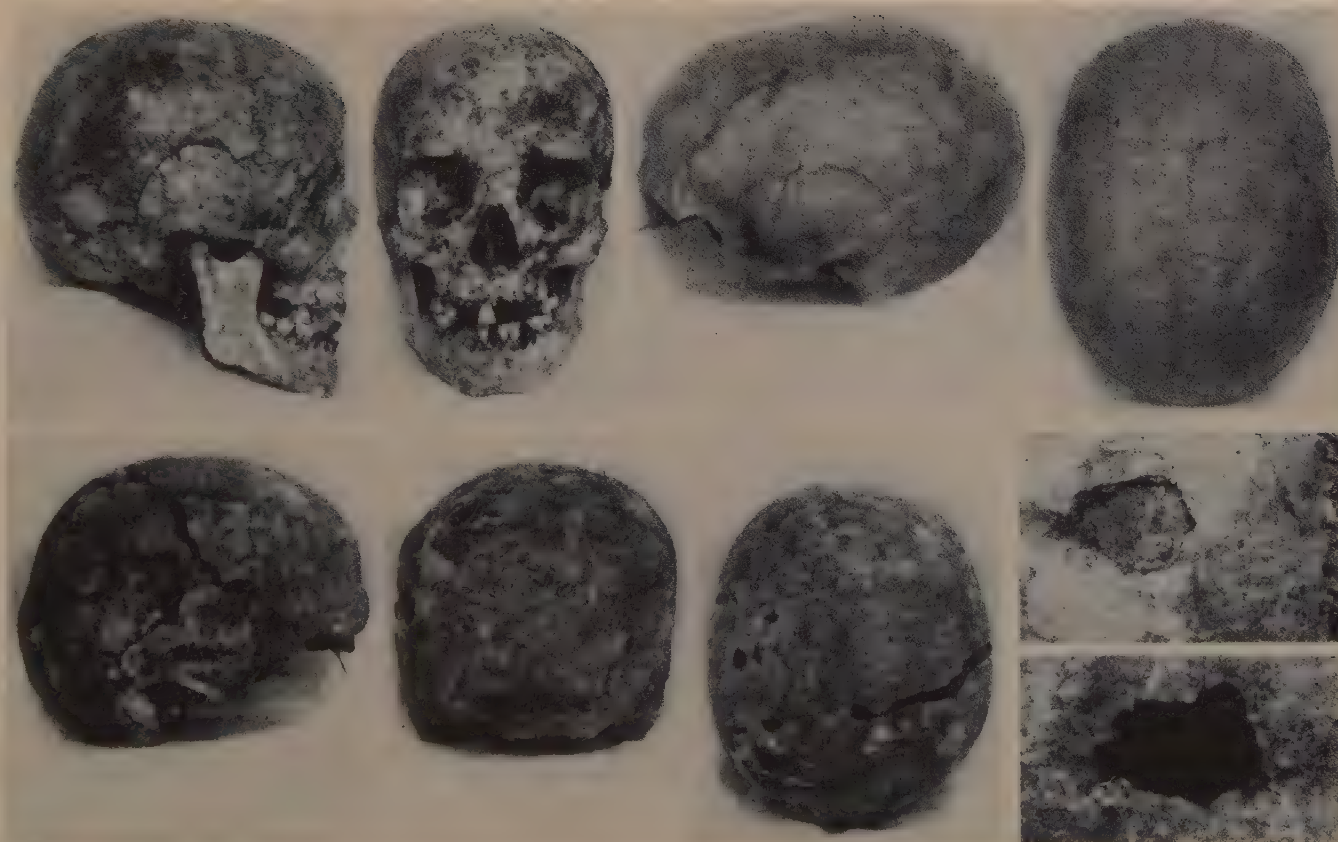
WALLIS, W. D. 1938 Anatomic Lag. Child Development, vol. 9, pp. 87–121.

31 Ce, upper, and 30 Ce, lower, from Mazarakata, to illustrate rugged and refined versions of the ''Megalithic'' trend in type A (Basic White).





5 Ce, upper, from Mavrata, and 1 Ce, lower, from Diakata, to illustrate gracile Mediterranean (type B) and Iranian tendencies in Mediterranean (type 3) respectively.



2 Ce, upper left, female from Diakata, and 33 Ce, upper right, from Mazarakata, to show Mixed Alpine blends. 36 Ce, lower left, from Mazarakata, illustrating the Alpine type (type C 4). In the lower right corner are enlarged views of an unsuccessful trephination (?) on 36 Ce, and a successful trephination on 23 Ce.

RELATIVE VARIABILITY OF INDIAN AND WHITE CRANIAL SERIES

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In 1936 Howells introduced a useful standard of variability for an anthropometric measurement known as the "mean "sigma." This standard as it relates to any particular measurement, is simply the mean of the standard deviations, calculated without weighting, from all the available series of fifty or more cases. Howells showed that it was necessary to have a minimum of fifty individuals in a series because "the average size of the standard deviation has a tendency to increase with the size of the samples, and to become less erratic . . . . " In this initial demonstration of the value of the mean sigmas for gauging individual standard deviations as well as series variability Howells limited his figures entirely to those on living males.

In 1938 von Bonin and Morant summarized the published male Indian cranial series from North America and included (table 12, p. 124), without so naming them, the mean sigmas. The writer and doubtless many others have found these figures of considerable value in comparing various Indian groups in the manner described by Howells.

A second contribution on this subject by Howells was published as a part of his analysis of the Gallen Priory crania, and consists merely of a list of mean sigmas for European cranial series. The minimum number for any one series in this tabulation appears to be 40.

In the course of my study of South American cranial series in connection with the forthcoming Handbook of the Indians of South America to be published by the Bureau of American

Ethnology I have had to calculate a number of standard deviations.[1] The mean sigmas derived from these data show some interesting differences when compared with those for the North American Indians and Europeans described above. I feel, therefore, that it will be useful to present these mean sigmas and to examine the differences shown in the comparisons in order to seek some explanation for these group variabilities.

Unfortunately, the available cranial series from South America are not always as large as the minimum specified by Howells. However, a fair number contain at least twenty-five specimens each. Those that meet this minimum requirement are identified by locality and author in table 1. In stating the number of specimens in a series, however, attention should be called to the fact that the number varies somewhat with the particular measurement. Thus, when deformity is present the number of normal vault diameters is reduced, while the numbers of certain facial measurements, which are relatively unaffected by deformity, are higher. For this reason I have indicated in table 1 the series in which deformity is present and reported the numbers of specimens yielding the cranial index.

The mean sigmas for these South American cranial series are presented in table 2, both for the total number of series of twenty-five or more specimens, and, as a check on the stability of the standard deviations, for only those series of forty or more specimens. For some measurements less than half of the total number of series consist of forty or more specimens each. However, the two sets of figures show that the mean sigmas derived from the larger series do not vary consistently from those derived from the total group: In the males eight out of fifteen are increased in value; in the females only six. According to these mean sigmas the females are slightly less variable than the males. Further generalizations probably are not warranted because of the small numbers involved.

[1] I am indebted to Marshall T. Newman for calculating others.

TABLE 1

South American cranial series for which standard deviations have been calculated.

LOCALITY OF TRIBE	DEFORMITY	NO. SPEC. YIELDING CR. INDEX ♂	♀	SOURCE
Argentina:				
Paraná delta	—	42	—	Torres, '11
Río Negro	+	54	44	Marelli, '13
Río Chubut	+	25	30	Marelli, '13
Late Araucano	+	27	45	Marelli, '13; ten Kate, 1892
Calchaquí valley	+	(122)[1]	(68)[1]	Constanzó, '42
Calchaquí valley	+	(116)[1]	(41)[1]	Kunike, '11
Brazil:				
Botocudo	—	31	—	Canestrini and Moschen, 1879; Ehrenreich, 1887; Fridolin, 1898; Hansen, 1888; Lacerda and Peixoto, 1876; Rey, 1880; Rodrigues Peixoto, 1885; Sergi, 1891; Schaaffhausen, 1877, 1878-80; Spengel, 1874; Virchow, 1874; Wieger, 1884; Zimmerman, '35
Chile:				
Araucano	—	25	—	Latcham, '04
Peru:				
Chancay	+	26	(31)[1]	Newman, '43, manuscript
Chicama, Moche and Virú valleys	+	65	58	Stewart, '43
San Damian	—	65	60	Newman, '43, manuscript
Paucarcancha, etc.	+	66	36	MacCurdy, '23
Machu Picchu	+	—	33	Eaton, '16
Region of Calca	—	32	—	Quevedo A., '42
Tierra del Fuego:				
Ona	—	25	—	Hrdlička, '11; Gusinde, '39
Yahgan	—	38	—	Gusinde, '39; Hrdlička, '11 Hultkrantz, 1898; ten Kate, '04
Venezuela:				
Cerro de Luna	+	50	31	Marcano, 1893
Ipi Iboto	+	—	25	Marcano, 1893
Cucurital	+	—	26	Marcano, 1893

[1] Orbital index; less than 25 available for cranial index.

TABLE 2

Mean sigmas of South American cranial series.

MEASUREMENT OR INDEX	MALES				FEMALES			
	Nos. (ser.-spec.)	Mean sigmas total series	Nos. (ser.-spec.)	Mean sigmas series of 40 spec.	Nos. (ser.-spec.)	Mean sigmas total series	Nos. (ser.-spec.)	Mean sigmas series of 40 spec.
Capacity	11-591	115.06	7-458	118.66	9-373	110.08	4-228	104.32
Max. length	14-580	5.49	6-348	5.64	10-391	5.38	4-208	5.44
Max. breadth	14-577	4.89	6-346	4.76	10-389	4.79	4-206	4.53
Bas.-breg. ht.	13-534	4.64	5-295	4.80	9-346	4.90	3-158	4.57
Upper fac. ht.	9-504	3.78	6-408	3.83	7-303	3.31	5-249	3.50
D. biz. max.	13-525	4.95	5-283	4.85	7-278	4.29	3-161	3.98
Orbital height	15-934	1.90	9-754	1.80	11-515	1.79	7-398	1.82
Orbital breadth	14-888	1.68	9-744	1.70	11-527	1.66	7-411	1.73
Nasal height	14-812	2.82	8-633	2.83	10-446	2.67	5-287	2.64
Nasal breadth	14-799	1.74	8-619	1.74	9-416	1.76	5-284	1.74
Cranial index	14-571	3.26	6-342	3.20	10-388	3.47	3-162	3.37
Mean ht. ind.	12-494	2.89	5-289	3.06	8-317	3.23	3-158	2.97
Upper fac. ind.	8-332	2.95	3-174	2.84	4-158	2.56	2- 94	2.52
Orbital index	15-950	5.30	10-807	5.33	12-581	4.95	8-460	5.22
Nasal index	15-850	3.90	8-674	3.90	10 472	4.20	6-339	4.31

More interest attaches to the comparisons between the mean sigmas of North and South American Indians and Europeans shown in table 3. The first thing to be noted here is that the figures for the two Indian groups are more often closer to one another than they are to the figures for Europeans; they are also lower than those for Europeans in the majority of cases and hence indicate a lesser variability than in the case of Europeans. Since we are uninformed in detail regarding the composition of the cranial series used by Howells in calculating the European mean sigmas, it would be unwise to speculate on the cause of the greater variability of this group.

The second point that I should like to call attention to is the relatively low variability of cranial capacity in the North American series. This point, it seems to me, is quite important, for I believe it can be shown to be due to personal bias in sexing crania. The mean sigma for North American cranial capacity is based mainly upon data in the Catalogue of

Crania prepared by Hrdlička ('27, '31). The only other material used in this connection is a series from Santa Cruz Island, California, measured by Hooton (Gifford, '26). The combination of capacity determinations by Hooton and Hrdlička on the Santa Cruz and Santa Rosa Island crania gives the largest standard deviation (110.2) of those used in determining the mean sigma. Von Bonin and Morant remark

TABLE 3

Comparison of mean sigmas for males: North and South American Indians, Europeans.

MEASUREMENT OR INDEX	NOS. (SER.-SPEC.)	MEAN SIGMAS S. AMER. IND.	NOS. (SER.-SPEC.)	MEAN SIGMAS N. AMER. IND.[1]	NOS. (SER.)	MEAN SIGMAS EUROPEANS[2]
Capacity	7-458	118.66	6- 335	99.5	6	121.22[3]
Max. length	6-348	5.64	14-1093	5.42	26	6.09
Max. breadth	6-346	4.76	14-1084	4.80	26	5.03
Bas. -breg. ht	5-295	4.80	14- 943	4.68	20	5.12
Upper fac. ht.	6-408	3.83	14- 839	3.94	23	4.28
D. biz. max.	5-283	4.85	12- 741	5.41	22	5.10
Orbital height	9-754	1.80	9- 533	1.67	12	2.00
Orbital breadth	9-744	1.70	9- 474	1.39	8	1.83
Nasal height	8-633	2.83	14- 932	2.83	16	3.03
Nasal breadth	8-619	1.74	14- 928	1.79	25	1.81
Cranial index	6-342	3.20	14-1073	3.12	23	3.22
Upper fac. index	3-174	2.84	—	—	8	3.30
Orbital index	10-807	5.33	9- 474	4.05	5	5.33
Nasal index	8-674	3.90	14- 919	4.15	15	4.49

[1] Von Bonin and Morant, '38.

[2] Howells, '41.

[3] Supplied by the writer largely from data in Biometrika.

that "It is certainly curious that Gifford's [Hooton's] Santa Cruz series should be distinguished by the smaller size of its type, not only from both Hrdlička's but also from Gifford's Santa Rosa series. The hypothesis that differences in sexing are responsible for these relationships seems to be a plausible one . . . . ." ('38, pp. 101-102).

The other five standard deviations from which this mean sigma is derived are based upon Hrdlička's data alone and are all low, ranging from 75.1 to 98.4. This consistently low

variability suggests that Hrdlička arbitrarily limits the capacities according to sex; or stated in another way, that he sexes the skulls partly on the basis of capacity. Indeed, I know this to be the case from personal experience. Often when the sex of a skull was in doubt he has said that the capacity would decide. The same idea is expressed more cautiously in his Practical Anthropometry ('39, p. 115):

> Skull capacity is a highly useful item in the sexing of skulls. Due mainly to a greater stature and basic bulk the male has a larger brain and hence larger cranial capacity than the female. The average difference between the two, in any given group, ranges from 150 to 200 cc. The female capacity in addition only seldom reaches above 1500 cc., while in the males, especially in some human aggregates, such occurrences are common. In general a capacity of above 1450 cc. suggests a male, capacity of 1300 cc. or less suggests a female. There are exceptions, but they rapidly grow rarer as one proceeds either above or below these figures.

This problem of sexing skulls is one that confronts everyone working with unidentified material, and it is evident that some such arbitrary rules must enter into every judgment of sex. Here, then, the mean sigma may not be measuring inherent racial variability so much as it is measuring human judgment. The problem is to distinguish between the two. Is it possible that such a difference in variability exists between Indians and Whites as the following figures for male cranial capacity indicate?

GROUP	NO.	AVER. CAPACITY	ST. DEV.	RANGE	AUTHOR
Sioux	57	1486.2	95.1	1270-1665	Hrdlička, '27
Arikara	43	1452.3	98.4	1280-1760	Hrdlička, '27
Whites [1]	1179	1452.3	116.8	1099-1782	Simmons, '42

[1] Dissecting room specimens and hence accurately sexed. Note the greater range in this group as compared to the Indians, which seem to have been arbitrarily limited near 1300, although admittedly the samples are small. In this dissecting-room series 10.3% of the males have capacities of 1300 cc. or less, whereas only 2.7% of the females reach or exceed 1500 cc. (Personal communication from Miss Simmons dated May 25, 1943).

If this group difference in the relative variability of capacity is due largely to error in sexing the Indian samples, as

the evidence suggests, then it seems possible that the low variabilities of all the measurements in the Indians may be due in part to this cause. Naturally, if the smallest male skulls were arbitrarily excluded from this sex series, the ranges of all the measurements might be limited correspondingly. In the same way, the upper part of the female range might be restricted. Against this possibility is the fact that the value of the mean sigma for capacity in the South American cranial series is more nearly like that for Europeans, and yet the other mean sigmas are low like those for North America. Also, it should be remembered that the mean sigmas for Europeans are based upon unidentified series that had to be sexed in the same way as the Indians. It does not seem likely that the sexing of the European crania would have been done so much more acurately than the Indian.

Another factor that perhaps tends to lower the mean sigmas for Indians is the small numbers in the series. Howells has pointed out ('36, p. 592) that "By and large, when the sample is small the sigma is erratic and may be either very low or very high (more often the former), since the extreme cases in the array affect it strongly; as the sample enlarges the sigma becomes less variable, and increases in absolute size, considerably at first, and then very slightly as the sample becomes very large." A series of forty such as I have used as a minimum in the present comparisons (table 3) may not be adequate to insure stability of the standard deviation. Nevertheless, as already pointed out, the South American mean sigmas based upon this number as a minimum are not increased consistently over those based upon all the series. These considerations suggest that in spite of individual biases in sexing and the small sizes of the series, the general relationship emerging from these records — that the Indian is less variable than the European — may be true.

SUMMARY

Mean sigmas of the principal anthropometric measurements and indices are presented by sex for a maximum of fifteen

South American Indian cranial series. Many of these series contain as few as twenty-five specimens. Comparisons are made between the mean sigmas of the series having a minimum number of forty specimens and the published mean sigmas for North American Indians and Europeans. In general the Indians show lower variabilities. Two factors that may account for this lower variability — error in sexing and inadequacy of sample — are discussed. It is regarded as unlikely that these two factors are responsible entirely for the lower variability of the Indian.

LITERATURE CITED

von Bonin, Gerhardt, and G. M. Morant 1938 Indian races in the United States. A survey of previously published cranial measurements. Biometrika, vol. 30, pp. 94–129.

Canestrini, Giovanni, and Lamberto Moschen 1879 Sopra due crani di Botocudi. Atti Soc. Veneto-Trentina Sci. Nat. Res. Padova, vol. 6, pp. 77–90.

Constanzó, María de las Mercedes 1942 Antropología calchaquí. La colección Zavaleta del Museo Argentino de Ciencias Naturales ''Bernardino Rivadavia.'' Rev. Inst. Antrop. Univ. Nac. Tucumán, vol. 2, no. 9, pp. 213–308.

Eaton, George F. 1916 The collection of osteological material from Machu Picchu. Mem. Connecticut Acad. Arts and Sci., vol. 5, 96 pp.

Ehrenreich, Paul 1887 Ueber die Botocudos der brasilianischen Provinzen Espiritu Santo und Minas Geraes. Zschr. f. Ethnol., vol. 19, pp. 1–80.

Fridolin, Julius 1898 Amerikanische Schädel. Arch. f. Anthrop., vol. 25, pp. 397–412.

Gifford, Edward Winslow 1926 Californian anthropometry. Univ. Calif. Publ. Am. Archeol. and Ethnol., vol. 22, pp. 217–390.

Gusinde, Martin 1939 Anthropologie der Feuerland-Indianer. III. (pt. 2) Anthropologie. Wien-Mödling, 511 pp.

Hansen, Søren 1888 Lagoa Santa Racen. En anthropologisk Undersøgeles af jordfundne Menneskelevninger fra brasilianske Huler. Med et Tillaeg om det jordfundne Menneske fra Pontimelo, ved Rio de Arrecifes, La Plata. E Museo Lundii, Copenhagen, vol. 1, no. 5, pp. 1–37.

Howells, W. W. 1936 Some uses of the standard deviation in anthropometry. Human Biol., vol. 8, pp. 592–600.

——— 1941 The early christian Irish: the skeletons at Gallen Priory. Proc. Roy. Irish Acad., vol. 46, sec. C, no. 3, pp. 103–219.

HRDLIČKA, ALEŠ 1911 [Measurements of three Fuegian skulls]. In "Los indígenas de la Tierra del Fuego," by Roberto Dabbene. Bol. Inst. Georg. Arg., vol. 25, nos. 7–8, pp. 283–287.

——— 1927 Catalogue of human crania in the United States National Museum collections: The Algonkin and related Iroquois; Siouan, Caddoan, Salish and Sahaptin, Shoshonean and Californian Indians. Proc. U. S. Nat. Mus., vol. 69, art. 5.

——— 1931 Catalogue of human crania in the United States National Museum collections: Pueblos, Southern Utah Basket-Makers, Navaho. Proc. U. S. Nat. Mus., vol. 78, art. 2.

——— 1939 Practical anthropometry. Philadelphia.

HULTKRANTZ, J. VILH. 1898 Några bidrag till Sydamerikas fysiska antropologi. Ymer, Stockholm, vol. 18, pp. 31–48.

KUNIKE, HUGO 1911 Beiträge zur Anthropologie der Calchaqui-Täler. Arch. f. Anthrop., N.F. Bd. 10, pp. 203–225.

LACERDA FILHO E RODRIQUES PEIXOTO 1876 Contribuições para o estudo authropologico das raças indigenas do Brazil. Arch. Mus. Nac. Rio de Janeiro, vol. 1, pp. 47–75.

LATCHAM, R. E. 1904 Notes on the physical characteristics of the Araucanos. J. Anthrop. Inst. Gr. Brit. and Ire., vol. 34, pp. 170–180.

MACCURDY, GEORGE GRANT 1923 Human skeletal remains from the highlands of Peru. Am. J. Phys. Anthrop., vol. 6, pp. 217–329.

MARCANO, G. 1893 Ethnographie précolombienne du Venezuela. Région des Raudals de l'Orénoque. Mem. Soc. Anthrop. Paris, 2nd ser., vol. 4, pp. 99–218.

MARELLI, CARLOS A. 1913 Contribución a la craneología de las primitivas pobociones de la Patagonia. An. Mus. Nac. Hist. Nat. Buenos Aires, tomo 26, pp. 31–91.

NEWMAN, MARSHALL T. 1943 A metric study of undeformed Indian crania from Peru. Am. J. Phys. Anthrop., n.s., vol. 1, pp. 21–45.

QUEVEDO A., SERGIO A. 1942 Los antiguos pobladores del Cuzco (región de Calca). II. Craneometría. Rev. Mus. Nac. Lima, tomo II, pp. 58–78.

REY, PHILLIPPE-MARIUS 1880 Étude anthropologique sur les Botocudos. Thèse de Paris, 85 pp.

RODRIQUES PEIXOTO, J. 1885 Novos estudos craniologicos sobre os Botocudos. Arch. Mus. Nac. Rio de Janeiro, vol. 6, pp. 205–256.

SCHAAFFHAUSEN, H. 1877 Die anthropologische Sammlung des Anatomischen Museums der Universität Bonn. Anthrop. Samml. Deutsch., pt. 1, 68 pp.

——— 1879–80 Die anthropologische Sammlung des Museums der Senckenbergischen Naturforschenden Gesellschaft und des Senckenbergischen Anatomischen Instituts, Frankfurt A. M. Anthrop. Samml. Deutsch., pt. 6, 15 pp.

SERGI, GIUSEPPE 1891 Crani Africani e crani Americani. Considerazoni generali craniologiche e antropologiche. Arch. p. Antrop. e Etnol., vol. 21, pp. 215–268.

SIMMONS, KATHERINE 1942 Cranial capacities by both plastic and water techniques with cranial linear measurements of the Reserve collection; White and Negro. Human Biol., vol. 14, pp. 473–498.

SPENGEL, J. W. 1874 Die von Blumenbach gegründete anthropologische Sammlung der Universität Göttingen. Anthrop. Samml. Deutsch., pt. 2, 93 pp.

STEWART, T. D. 1943 Skeletal remains with cultural associations from the Chicama, Moche, and Virú valleys, Peru. Proc. U. S. Nat. Mus., vol. 93, pp. 153–185.

TEN KATE, HERMAN 1904 Matériaux pour servir à l'anthropologie des Indiens de la Republique Argentine. Rev. Mus. La Plata, vol. 12, pp. 31–57.

TORRES, LUIS MARÍA 1911 Los primitivos habitantes del delta del Paraná. Univ. Nac. La Plata, Bibl. Cent., tomo 4, 616 pp.

VIRCHOW, RUDOLPH 1874 Schädel von Araucanos und andern Südamerikanern. Verhandl. Berl. Gesell. f. Anthrop., Ethnol. u. Urgesch., Sitz. vom 12 Dec., pp. 7–12 (258–263).

WIEGER, G. 1884 Die anthropologische Sammlung des Anatomischen Instituts der Universität Breslau. Anthrop. Samml. Deutsch., pt. 12, 45 pp.

ZIMMERMANN, GÜNTER 1935 Uber einige interessante Schädel aus Süd-amerika. Mitt. Anthrop. Gesell. Wien, vol. 45, no. 3-4, pp. 194–203.

PREDICTION OF HEART WEIGHT IN MAN[1]

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FOUR FIGURES

It happens to be 100 years since Reid published his observations on important organ weights, in order to afford bases of comparison for organ weights at individual autopsy. Such comparisons might seem of concern only to pathologists, but today the growing interest in the relation of constitution to disease should enlist the concern of clinical men. Cardiologists in particular, who wish to estimate the size of the heart by radiological examination in the living, may well find autopsy weights valuable as controls.

During this past century a dozen observers have published raw data on heart weight, and a few have tried to reduce their series to usable form. The results have received little acceptance by other workers. Yet plainly the aim is worth further effort. Fortunately a number of editors have had the foresight to find place in their journals for dull tables of data, so that these can be treated afresh by more modern methods, diagrammed for easy visual comparison, and reduced to really useful rules.

Weights available for study are necessarily due to vision on the part of pathologists. The observations are affected by circumstances prior to autopsy, which are so imperfectly known as to make suitable allowance difficult. Some of the circumstances undoubtedly decrease (occasionally increase) the body weight, and others probably increase the heart weight. For example, if a series happens to have been on the

[1] Aided by a grant from the Rockefeller Fluid Research Fund.

whole emaciated, the formula calculated from it will, when applied generally, predict heart weights which will be too heavy for use as standards. Similarly, if a series includes a considerable number of cardio-renal cases, the formula will again predict hearts too big for norms. In the other direction, a series loaded with obese or edematous cases will yield predicted heart weights which will be too low. In spite of reservations, however, existing data promise practical usefulness if reduced to a reasonably reliable rule. The calculations have indeed been tedious to get generalizations; but the formulae involve no lofty calculus, are quite within the grasp of the medical man if interested, and can once for all be turned into a usable table with a small amount of effort of head and hand.

METHODS

1. The current concept of an average weight for a human heart is crude. Clearly it should be related to body size, either weight or length. In the present study body weight has been used as the measure of body size.

2. Heart weight as a percentage of body weight, used by a few biologists, is inadequate because the percentage is too variable.

3. Heart weight as a straight line function of absolute body weight, used by a few investigators, affords an approximation. But this also is inappropriate, as is instantly evident on plotting a series of individual heart weights on a vertical scale against the corresponding body weight on the horizontal axis; the points form a stream curving up to the right, but flattening out as body weight increases.

4. The log log relation is the newest and best method. This is the logarithm of heart weight as a straight-line function of logarithm of body weight. By this method, the curved stream mentioned in the last paragraph is readily rectified, i. e., translated to a straight stream, which is obviously much more convenient.

The concise algebraic expression of the curved stream is a parabola $y = bx^{\alpha}$, where $x =$ the independent variable, namely the body weight in grams, $y =$ the dependent variable, namely the heart weight in milligrams, $\alpha =$ the slope of the line, or growth rate constant, and $b =$ the initial growth index, or the value of y when $x = 1$. To obtain a straight stream we take common logarithms of both the variables, body weight and heart weight, i. e., of the parabolic equation given above, and we get:

$\log y = \log b + \alpha \log x$, or
$Y = \log b + \alpha X$, where
$X =$ log of body weight,
$Y =$ log of heart weight,
$\alpha =$ the slope of the line.

In short, we work entirely with logarithms of the heart and body weights instead of with the observed weights. This relative growth function has been found extremely useful in studying the relation of a part to the whole in various animals, and by a number of biologists. Their work need not be listed here since it can be easily traced in the journal Growth.

For each reported series of the same sex, the individual weights were converted to logarithms, these were plotted, lines were drawn along the upper and lower borders of the stream, and outlying values were omitted (usually about 1% of the number in the series). Lastly the left end of the stream was truncated by a vertical drawn where youth caused a significant change in slope of the stream, usually about the age of 14 years, though earlier in some series; this arbitrary restriction of range in the data to be treated has been considered necessary and legitimate by several investigators of log-log fits to biological growth.

The pruned observations in each series were then reduced by least squares to a linear equation. The equation lines for comparable series were drawn on squared paper, manifesting a central group agreeing fairly well in position and slope. There were also some outlying lines peculiar in one or both of these respects; and these lines were treated separately.

RESULTS

Basic constants. In order to present in manageable form the 5789 individual human hearts collected from the literature, the raw data have been reduced to basic constants. These are put on record in table 1 for males, in table 2 for females. Each author's series was calculated separately and the prediction-equation-line plotted. Guided by the diagrams, the equations were then arranged in the tables in three groups, or panels: The Young; the Better Central Lines for adults, which we have pooled to obtain an equation for general application, and the Outlying Lines for adults, which we have considered inferior and discussed only secondarily.

Units of measurement. Since the present paper is part of a more comprehensive study of the heart and other organs in man and other animals, the obvious standard units for comparative purposes are grams for body weights and milligrams for organ weight. These therefore have been used in the basic tables 1 and 2, and in the diagrams. But for man, of course it will be handier to have the body weight in kilograms and heart weight in grams. Accordingly, the general equation for males may be written alternatively as below, using E for the expected value of Y, to distinguish it from the observed value of Y, and using the conventional bar over a letter to indicate a mean.

IN GM. AND MG. FROM TABLE 1.	IN KG. AND GM. FOR TABLE 3.
$E = \overline{Y} + a\ (X - \overline{X})$	
$= 5.5014 + 0.7765\ (X - 4.7504)$	$= 2.5014 + 0.7765\ (X - 1.7504)$
$= 0.7756\ X + 1.813$	$= 0.7765\ X + 1.142$
$= aX + \log b$	

From the last equation in the second column, which we shall refer to as equation I, we can solve a table for practical use; for example, if we should require body weight intervals of 1 kilo, the work would run as in table 3.

Adult central lines. The more important results will now be pointed out, with the aid of some simple diagrams. Among the male series studied there were six prediction lines which ran fairly snugly in a central group, and are therefore reproduced in figure 1, as being the best basis for an equation

TABLE 1

Men

Reduced data for log (Heart weight in mg.) = Y, and log (Body weight in gm.) = X

SERIES	NO. OF HEARTS STUDIED	NO. OF ITEMS USED IN CALCS.[1]	AGE RANGE	MEAN X = $\bar{X}$	MEAN Y = $\bar{Y}$	SLOPE	LOG b
Adult, better lines							
Reid, 1843 and Peacock, 1846	88	88	20-60	4.7122	5.4862	0.9571	0.9762
Oppenheimer, 1888, "Accident"	107	35	13-25	4.7691	5.5122	0.8469	1.4732
Oppenheimer, 1888, Illness	137	101	13-25	4.7380	5.4540	0.7004	2.1357
Greenwood & Brown, '13	78	78	25-55	4.7527	5.5221	0.7844	1.7941
de Jesus, et al. '33	633	633	Adult	4.6790	5.4405	0.6781	2.2679
Kirch, '35, '36	13	13	15-25	4.8517	5.5936	0.6920	2.2364
Pool	1056	6	13-60	4.7504	5.5014	0.7765	1.8128
Adult, outlying lines							
Blosfeld, 1864	155	155	Adult	4.7901	5.5700	0.5638	2.8694
Dieberg, 1864	72	72	Adult	4.7749	5.5756	0.6576	2.4356
Müller, 1883	477	7	21-90	4.7090	5.5023	0.2375	4.3839
Smith, '28	534	7	18-80	4.8145	5.4680	0.5070	3.0270
Roessle & Roulet, '32	446	446	20-70	4.7398	5.4992	0.5797	2.7516
Crile & Quiring, '40	28	28	Adult	4.8034	5.5095	0.9779	0.8122
Pool	1712	715	18-80	4.7571	5.5224	0.7853	1.7868
Young							
Boyd, 1861	204	8	1m-20y	3.9296	4.7464	1.0367	0.6726
Müller, 1883	181	7	2m-20y	4.0757	4.8473	0.9891	0.8161
Oppenheimer, 1888 "Accident"	9	9	2-10	4.1955	4.9934	1.0427	0.6186
Oppenheimer, 1888 Illness	94	94	1-11	4.1479	4.8789	1.0438	0.5494
Rössle & Böning, '24	208	208	2-20	4.3960	5.1215	1.0023	0.7155
Smith, '28	56	4	2-17	4.4584	5.0768	1.0449	0.4182
Roessle & Roulet, '32	85	85	1-19	4.5005	5.2136	1.0392	0.5364
de Jesus, '33	180	180	1-10	4.2480	5.0162	0.9396	1.0248
Pool	1017	595	1m-20y	4.3143	5.0540	0.9630	0.8993

[1] The number of items used in calculations was sometimes less than the number of individuals collected for study, because in some series the individuals had been reported already in groups, which therefore we had to use instead of an individual, on each row of the work-sheets.

TABLE 2

Women

Reduced data for log (Heart weight in mg.) = Y, and log (Body weight in gm.) = X

SERIES	NO. OF HEARTS STUDIED	NO. OF ITEMS USED IN CALCS.	AGE RANGE	MEAN X = $\bar{X}$	MEAN Y = $\bar{Y}$	SLOPE	LOG b
Adult, better lines							
Reid, 1843 & Peacock, 1846	41	41	20-60	4.6416	5.4163	0.7080	2.1299
Müller, 1883	390	7	21-90	4.6379	5.4105	0.9467	1.0195
Oppenheimer, 1888, "Accident"	14	14	13-25	4.7106	5.4321	0.7382	1.9546
Oppenheimer, 1888, Illness	131	131	13-25	4.7189	5.4063	0.8227	1.5239
Roessle & Roulet, '32	119	119	20-70	4.7303	5.4494	0.6297	2.4707
Pool	695	5	13-90	4.6879	5.4229	0.7691	1.8177
Adult, outlying lines							
Blosfeld, 1864	19	19	Adult	4.7353	5.4915	0.4861	3.1896
Dieberg, 1864	11	11	Adult	4.7587	5.4889	0.4078	3.5485
Smith, '28	320	6	18-80	4.7728	5.3980	0.5171	2.9299
de Jesus, '33	153	153	11-60	4.6270	5.3762	0.3926	3.5598
Crile & Quiring, '40	8	8	Adult	4.6968	5.4710	0.9661	0.9335
Pool	511	197	11-80	4.6521	5.3981	0.5265	2.9488
Young							
Boyd, 1861	198	8	1m-20y	3.8852	4.7238	1.0564	0.6194
Müller, 1883	186	7	2m-20y	4.0706	4.8290	0.9248	1.0643
Oppenheimer, 1888, "Accident"	2	2	2-10	4.1139	4.8451	1.5926	−1.7067
Oppenheimer, 1888, Illness	87	87	1-11	4.1368	4.8851	1.2832	−0.4234
Rössle & Böning, '24	171	171	2-20	4.4310	5.1302	0.9861	0.7607
Smith, '28	28	4	2-17	4.4042	5.0130	1.0259	0.4948
Roessle & Roulet, '33	49	49	1-19	4.3446	5.0464	0.9245	1.0299
de Jesus	77	77	1-10	4.1499	4.9359	0.9591	0.9558
Pool	798	405	1m-20y	4.2851	5.0147	0.9184	1.0793

of general application. The numerical value of the formula has just been paradigmed.

For adult women, similarly, the central lines are exhibited in figure 2, and their pool yields the general prediction formula just solved in table 3 for comparison with the men.

Adult outlying series. A number of the series studied yielded regression lines which lay strikingly far from the central stream, and which therefore have been treated separately.

TABLE 3

Sample solution of formula

BODY WEIGHT		ADULT MALE = EQUATION I			ADULT FEMALE = EQUATION II		
Kg. = BW	Log = X	.7765X = aX	+ 1.142 = E = log (HW)	Antilog = HW in gm.	.7691X = aX	+ 1.125 = log (HW)	Antilog = HW in gm.
64.0	1.806	1.402	2.544	350	1.389	2.514	327
65.0	1.813	1.408	2.550	355	1.394	2.519	330
66.0	1.820	1.413	2.555	359	1.400	2.525	335

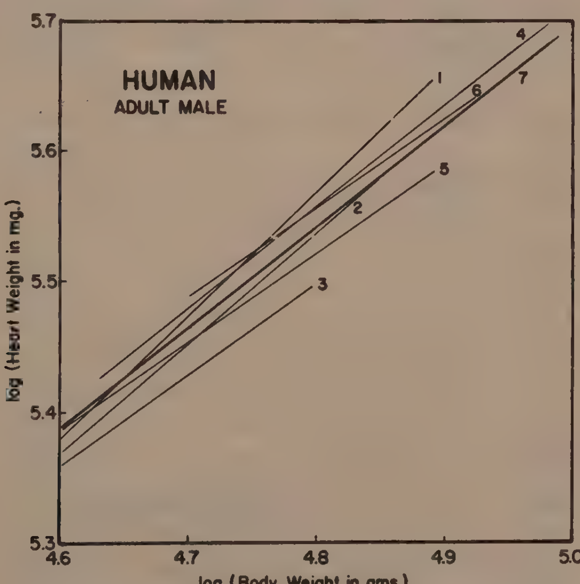

Fig. 1 Adult male prediction lines running in a central group. 1. Reid (1843) and Peacock (1846), 2. Oppenheimer (1888, accid. ser.), 3. Oppenheimer (1888, illness, ser.), 4. Greenwood and Brown ('13), 5. de Jesus, et al. ('33), 6. Kirch ('35, '36), 7. Pool of these central lines.

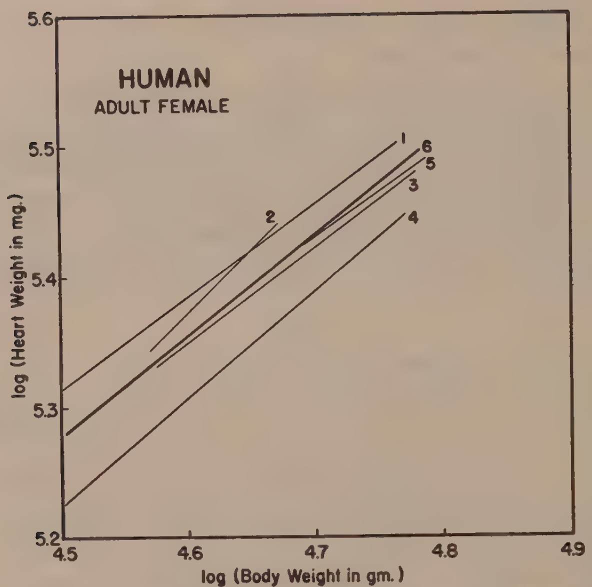

Fig. 2 Adult female prediction lines running in a central group. 1. Reid (1843) and Peacock (1846), 2. Müller (1883), 3. Oppenheimer (1888, accid. ser.), 4. Oppenheimer (1888, illness, ser.) 5. Roessle and Roulet ('32), 6. Pool of these central lines.

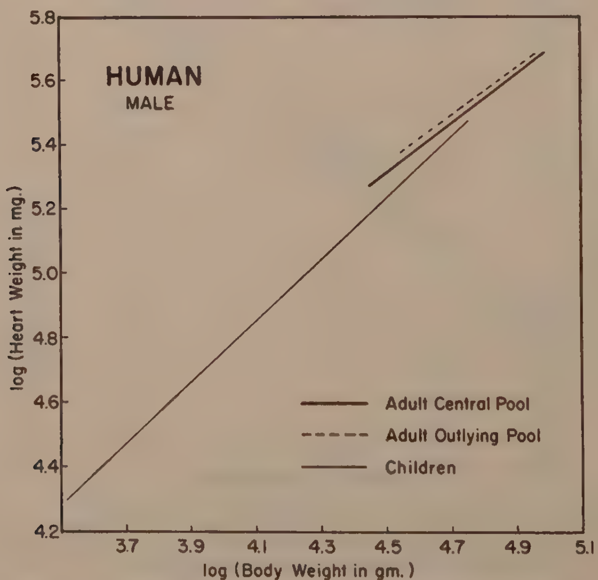

Fig. 3 Prediction lines of the three pooled male groups.

There were six for males, each put on record in table 1, and their pool diagrammed in figure 3; similarly there were five outlying series for females, and their pool is shown in figure 4. The reader critical enough to go back to the original authors may of course consider some particular one so superior in the selection of his sample that he deserves to be accepted as a norm rather than the pools here presented.

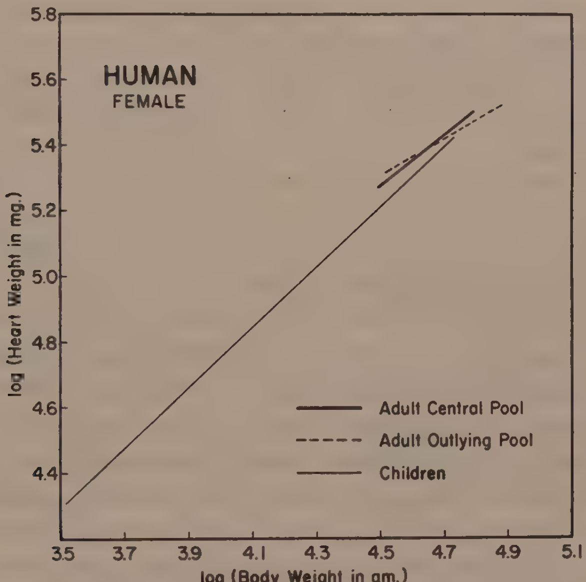

Fig. 4 Prediction lines of the three pooled female groups.

It may be objected that in figure 1 lines 1 and 3 should not have been included in our pooled estimate for the best prediction line 7; and similarly for females in figure 2, that lines 1 and 4 should have been omitted. In answer we emphasize that about half of the series calculated have already been omitted as being too outlying, hence, by comparison with these, we believe that the debatable lines mentioned are fairly included, especially as they lie one above and one on the low side of the central area.

The young. Children's hearts needed separate treatment in general, though in some series they lay in the same stream

with the adults, projected back even to infancy. The reduced constants are put on record in table 1, and the pool for boys drawn in figure 3, for girls in figure 4. Both sexes show the same two things: 1. The lower position of the line means that, for a given body weight, the child's heart is smaller than the adult's; 2. The steeper slope of the line means that the child's heart grows faster than the adult's.

Race. Most of the series are from American, British and German sources. The exception is de Jesus's set on Filipinos. The question arises as to the propriety of including this set. The males are seen in figure 1, line 5, to lie somewhat below the heavy average line 7. This position might suggest that the Filipinos had somewhat smaller hearts for any given body weight, as against the other races; but on the other hand the Filipino line lies closer to the average than several of the "outlying lines" tabulated in the second panel in table 1, but not reproduced. Accordingly these males have been used in composing the pooled average line 7. The Filipino female line lay among the outlying lines for the sex, and therefore were omitted in composing the female formula.

Variability. Any predicted heart weight has inherently a certain amount of sampling error, due to human fluctuations within any sample or group of persons, no matter how homogeneous. Such variation is conventionally measured by the standard deviation. This criterion was computed by Rosahn as 50 gm., by Zeek as 40 gm. for males and 30 gm. for females. From these values we are content to take 40 gm. as a convenient measure of the range above and below a predicted heart weight, within which the observed heart weight should fall if it is to be considered normal.

Limits of applicability. The range of body weight used in computing the formulae varied somewhat according to the observations reported by the several authors studied. Here it will suffice to record the ranges for our main results:

1056 adult males	:	28 to 98 kg.
695 adult females	:	31 to 61 kg.
1017 young males	:	3.26 to 57 kg.
798 young females	:	2.78 to 54 kg.

Surface area. The literature is full of persistent efforts to relate various biological variables, notably calories burnt in metabolism, to surface area estimated as $BW^{\frac{2}{3}}$. This notion receives no support from the present results, because the exponent 2/3 or .667 is much too far from the body weight exponent obtained in this paper, averaging .769 for women and .776 for men.

Athlete's heart. Hypertrophy from certain sports is suggested in figure 1, line 6, calculated from the observations due to Kirch. Although it fails to be the highest of all lines, the suggestion is made more probable by his ingenious experiments with swimming rats.

Normality of body weight. The effect of over weight and under weight must be considered. Fat and emaciated subjects do not show heart weights approximating those estimated by our formulae. This statement was not warranted on the basis of the series diagrammed, but after our calculations were written up there came to hand some series which permit the conclusion. For when the fat subjects are plotted (not reproduced) the hearts lie below our line; and when starved rats (since we have no starved men) are plotted the hearts lie above our line for rats. To explain these findings jointly, the hypothesis is plausible that gains or losses in body weight are much more marked than in the heart. These recent series of good observations deserve therefore a brief analysis, which follows.

Smith and Willius' obese. These authors recorded observations on fifty-two cases of obesity without demonstrable evidence of heart disease. These we have treated like the other series studied above; we omitted three cases which plotted way off the stream, and calculated equation III for both sexes together:

$$E = 0.4976 + 1.034X,$$

where E = logarithm of (HW in gm.), as expected.
X = logarithm of (BW in kg.), as observed.

This line lies far below our general adult line, and even considerably below the line we have calculated from Smith's own normals. Thus it is plain that for obese people heart weight cannot be properly predicted from our general equation, and that for them the best estimate at the present time is the formula just given.

Addis' starved rats. Thanks to unpublished data on 128 male albino rats, starved for 7 days, we have computed equation IV:

$$E = 1.192 + 0.718X$$

where E = the expected log (HW in mg.) and
X = the observed log (BW in gm.).

This line lies parallel to and well above the line for 1096 albino males on stock diet. Hence it is apparent that during starvation the heart weight does not diminish to the same degree as does the body weight.

Rosahn's normal men. His data at Yale since 1917 covers males aged 20 years and over with no cardiovascular disease at autopsy, who died either from trauma or from an acute disease. This selection is unusually choice, and the author has kindly furnished a transcript of the unpublished raw data. These we have treated like the other series analyzed: plotting log heart weight against log body weight for all, ruling lines approximately parallel along the edges of the stream, and omitting the outlying points, which were 5 above and 8 below the stream, i. e., 7% of the total 187, and from the remaining 174 calculating by least squares, the regression formula, which we shall call equation V:

$$E = 1.219 + 0.7257X$$

This corresponds reasonably with our equation I for males:

$$E = 1.142 + 0.7765X;$$

and if plotted on figure 1 would lie slightly below our heavy line. Our formulas in terms of logarithms yield estimates closer to observations than does his formula in terms of ab-

solute weights in kilograms and grams, which we shall call equation VI:

$$\text{HW in gm.} = 140 + 3.2\ (\text{BW in kg.}).$$

The proof will be given in the following section.

TESTS OF ACCURACY OF PREDICTION

Material. As cases on which to test the more important of the prediction equations, we have taken two series of males aged 20 years or more.

A. Stanford autopsy records, taken consecutively until forty were obtained, after excluding those with carcinoma or other disease likely to affect body weight, on the one hand; and on the other hand those with hypertension or cardiovascular disease sufficiently marked to suggest the likelihood of an effect on heart weight. There were unfortunately few available deaths from trauma, acute infection, or other disease requiring hospitalization of less than a fortnight's duration, although 940 protocols were reviewed. Of this total sieved, the desired number of forty cases was therefore 4.3%, almost identical with the severity of Rosahn's sieving. The resulting test material, though not ideal, had the merit that it was a totally new series, and had not been used in the calculation of any of the prediction formulas to be tested.

B. Yale autopsy records, taking the first forty of the slightly pruned Rosahn data already treated above. This series is the most normal of which we are aware. Clearly it will favor the formula we have computed from it, and Rosahn's own; and will be strictly just to formulas based on other series.

Equations tested. Those most important to us are the following, for males:

I. Our log-log formula, based on 1056 from various authors.

V. Our log-log formula based on 174 of Rosahn's series.

VI. Rosahn's formula without logarithms, based on 187 of his series.

Method of test. For each formula the simple but rather laborious arithmetic procedure was as follows: The expected heart weight was computed from the equation, its deviation from the observed heart weight noted and divided by the observed, affording a plus (predicted value too heavy) or minus error, expressed as a percentage of the observed. These errors were added, without regard to sign, and divided by 40, the number of cases, to obtain the average error for each equation. The number of times the prediction was too heavy and too light are also recorded in table 4.

TABLE 4

Accuracy of prediction

TESTED ON	SOURCE OF EQUATION		EQUATION NO.	PREDICTION		AVERAGE ERROR IN % OF OBSERVED
	Material	Calculated by		Too high	Too low	
Stanford autopsies	1056 males from various authors	us	I	20	20	14.54
	174 males from Yale	us	V	16	24	14.76
Yale autopsies	1056 males from various authors	us	I	30	10	10.90
	174 males from Yale	us	V	26	14	9.02
	187 males from Yale	Rosahn	VI	30	10	9.76
	357 males from Cincinnati	Zeek	VII	15	25	10.02

Results. On the Stanford sample our formula based on the past literature yielded the smaller percentage error. On the Yale sample, the smallest error resulted, as would be expected, from our equation based on essentially the same material; and, more important, that equation V, which is in logarithmic terms, was slightly better than equation VI, which is expressed in absolute terms of kilograms and grams.

Addenda. As this work was being completed our attention was drawn to a publication by Zeek ('42) in which is contained a prediction formula using body length instead of body weight. This formula, based on 357 normally nourished adult males from Cincinnati, relates absolute heart weight to body length without the use of logarithms:

$$\text{HW in gm.} = 1.9 \text{ (BL in cm.)} - 2.1$$

We have designated this equation as VII among those tested (table 4). As used on the Yale adult male sample it showed a slightly better performance in comparison with our equation I based on logarithm of body weight. Whether it is superior also for adult females and for children remains to be proven. However, the present test is significant in view of the fact that Zeek's formula is based on material differing from that used in the test, and also because it involves a different measure of body size as compared with the other formulas.

Summary. Prediction of normal heart weight can be better performed by the use of the relative growth formula than by prior methods. This method, namely, logarithm of heart weight against logarithm of body weight, has been applied to 5789 human hearts, and the calculations converted to ordinary linear equations and tabulated for the special student of the heart. For more immediate use, the main equations are diagrammed, and the method of making a table for practical use is illustrated simply.

As this work was being completed, we received Zeek's method of prediction based on body length; it seems to yield slightly greater accuracy than our method based on body weight for adult males. Whether it is superior for adult females and for children remains to be proven.

It is a pleasure to acknowledge the assistance of Miss Ann Benson and Mrs. Sylvia Miller.

LITERATURE CITED

BARDEEN, C. R. 1918 Determination of the size of the heart by means of X-rays. Am. J. Anat., vol. 23, p. 423.

BLOSFELD, G. 1864 Organostathmologie, oder Lehre von den Gewichtsverhältnissen der wichtigsten Organe des menschlichen Körpers. Henke's Zeitschr. f. d. Staatsarzneikunde, Bd. 44, S. 1.

BOYD, R. 1861 Tables of the weights of the human body and internal organs in the sane and insane of both sexes at various ages, arranged from 2614 post-mortem examinations. Phil. Transact., Roy. Soc., London, vol. 151, p. 241.

CRILE, G., AND D. P. QUIRING 1940 A record of the body weights and certain organ weights of 3690 animals. Ohio J. Sci., vol. 40, p. 219.

DE JESUS, P. I., W. DE LEON, AND J. M. RAMON 1933 Normal weights of visceral organs in Filipinos in relation to length and body weight. Philippine J. Sci., vol. 52, p. 119.

DIEBERG, C. 1864 Das Gewicht des Körpers und seiner einzelnen Organe. Casper's Vierteljahrschrift f. gerichtl. und offentlich. Medicin, Bd. 25, S. 127.

GREENWOOD, M., AND J. W. BROWN 1913 A second study of the weight, variability and correlation of the human viscera. Biometrika. vol. 9, p. 473.

KIRCH, E. 1928 Über das Zustandekommen der physiologischen und pathologischen Herzerweiterungen und des sog. Sportherzens, Zts. f. Kreislaufforschung, Bd. 20, S. 132.

——— 1930 Verhalten des Herzens beim körperlichen Anstrengungen und beim Sport, in Lubarsch-Ostertog-Frei's Ergebnisse d. Allg. Path., Bd. 23, S. 392.

——— 1935 Anatomische Grundlagen des Sportherzens. Verhandl. d. dtsch. Gesellsch. f. innere Med. Bd., 47, S. 73.

——— 1935 Ueber das Sportherz. Munch. Med. Woch. Bd. 82, S. 1256.

——— 1936 Herzkräftigung und echte Herzhypertrophie durch Sport. Zts. f. Kreislaufforschung, Bd. 28, S. 893.

KIRCH, E., AND W. GRÜNBAUER 1938 Über tierexperimentelle Herzhypertrophie bei Laboratoriumsratten durch trainingsmässiges Schwimmen. Ziegler's Beit. z. Path. Anat., Bd. 100, S. 354.

KLATT, B. 1919 Zur methodik vergleichender metrischer Untersuchungen, besonders des Herzgewichtes. Biol. Zentralbl., Bd. 39, S. 406.

MÜLLER, W. 1883 Die Massenverhältnisse des menschlichen Herzens. Voss, Hamburg und Leipzig. (His observations have been treated by Bardeen and by Klatt with results somewhat different from ours.)

OPPENHEIMER, K. 1888 Ueber die Wachsthums-Verhältnisse des Körpers und der Organe. Inaug. Diss., Munchen.

——— 1889 Ueber die Wachsthumsverhaltnisse des Körpers und der Organe. Zts. f. Biol., Bd. 25, S. 328.

PEACOCK, R. 1846 Table of the weights of some of the organs of the human body. London & Edin. Monthly J. Med. Sci., vol. 7, NS 1, p. 101.

Reid, J. 1843 Tables of the weights of some of the most important organs of the body at different periods of life. London & Edin. Monthly J. of Med. Sci., vol. 3, p. 295.

Rössle, R., and H. Böning 1924 Das Wachstum der Schulkinder, in Veröffentlichungen aus der Kriegs und Konstitutions-pathologie, Jena, vol. 4, Heft 1.

Roessle, R., and F. Roulet 1932 Mass und Zahl in der Pathologie, Berlin.

Rosahn, P. D. 1941 The weight of the normal heart in adult males. Yale J. Biol., vol. 14, p. 209.

Smith, H. L. 1928 Relation of weight of heart to weight of body. Am. Heart J., vol. 4, p. 79.

Smith, H. L., and F. A. Willius 1933 Adiposity of the heart. Arch. Int. Med., vol. 52, p. 911.

Zeek, P. M. 1942 Heart Weight I. The weight of the normal human heart. Arch. Path., vol. 34, p. 820.

STUDIES IN THE PHYSICAL DEVELOPMENT OF NEGROES

II. WEIGHT

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INTRODUCTION

Weight, a commonly used measure of the nutritional status and general well-being of the infant, can be accurately and conveniently obtained at early ages. Surveys on older individuals are often complicated by the factor of clothing. Moreover, when evaluating the average weight of a series derived from adults, one encounters a variability of rather wide range, and this necessitates a very great number of cases in any comparative investigation. Therefore, the present report is restricted to observations made on infants under two years of age.

My data represent consecutive observations on Negroes and Whites. The measurements on Negroes were obtained in the Harlem clinics of the Department of Health, New York City. The data on Whites were furnished by Dr. Nellie Marmor from her office records. In view of her long affiliation with these clinics and knowledge of their dietary regime she could apply the latter to the children seen in her private practice. Thus, at least one common factor, the mode of nutrition, enhanced to a certain degree the comparability between the material on both races.

All weights were taken without clothes.

I have compared the material assembled by myself in 1935–1936 with that collected 1½ decades prior by R. M. Woodbury ('21), and I have arranged the latter's figures in the same

manner as my own, using intervals of 3 months for successive age groups. By this procedure the averages calculated from the older study were rendered comparable with those of my series.

The following problems are being dealt with in this section:

1. Seasonal variations in birth weights. This problem is linked with the question of whether, or to what degree, the maternal organism responds to natural environmental conditions which could possibly modify the birth weight.

2. The problem of the smaller birth weight of the Negroes, relative to the birth weight of Whites. Such aspects as possible racial differences in size or position of the pregnant uterus, birth order, immature birth, age of the mother and economic status are included in the discussion.

3. The secular increase in weight among White and Negro children.

4. Comparison of weight increment between infants of both races raised on an identical diet.

A note regarding rickets among Negroes in New York City is appended.

THE PROBLEM OF SEASONAL VARIATION AS EXPRESSED BY THE WEIGHT OF THE NEW-BORN

In view of the acceleration of growth in winter, it is interesting to see whether children born in different seasons of the year show a different birth weight. It is usually assumed that the more rapid growth of children during the winter months is caused by the cumulative effect of sun exposure during the preceding season. Therefore the question arises whether the growth stimulus exerted by sun radiation is transmitted through the expectant mother to the unborn child.

To investigate this problem I availed myself of a uniform sample of children born to mothers living in Harlem, New York City, and having the same prenatal care at the same Department of Health district, all belonging to a homogenous colored stock. This study showed the weight of children born in each of the four seasons to be the same (table 1).

TABLE 1

Weight in kilogram at birth according to season: Female Negro infants.[1]

TIME OF BIRTH	NO.	MEAN	VARIABILITY
Dec., Jan., Feb.	157	3.17	± .47
March, April, May	106	3.12	± .52
June, July, August	94	3.20	± .56
Sept., Oct., Nov.	93	3.12	± .45

[1] These data cover a period of several years leading up to 1936.

The literature on seasonal birth weights contains contradictory reports. Brenton ('22), Hellmuth ('28), Bakwin and Bakwin ('29, '34) found a seasonal stability in birth weight. In contrast to the findings of these investigators and those reported in the present study, Adersen (1899) observed higher birth weights in infants born during the cold months; Hansen ('13) in those born in the fall; Abels ('26) in those born during the summer; and Li ('36) in those conceived in the autumn. Peterson and Mayne ('43) concur with Li's opinion.

On the basis of their material, Peterson and Mayne concluded, among other things, the following: first, that the periods of lesser or greater sun spot activity influence seasonal variation of birth weight, the variability in habitus (weight to length ratio) showing crests corresponding to periods of greater sun spot activity; second, that climatic conditions of short duration, such as warm temperature at the time of conception, will cause relatively heavy and short offspring regardless of season.

In order to support the first hypothesis, one would have to obtain seasonal birth weights for successive years covering many decades, with the view to demonstrating a consistent correlation between stability in seasonal birth weights and periods of lesser sun spot activity, on the one hand; and between seasonal variations in birth weights and periods of greater sun spot activity, on the other. The second finding by Petersen and Mayne cited herein and presented by them as a cause and effect relationship, is open to criticism since the authors admit the lack of dietary records at the time of conception. Moreover, the possible effects of diet during preg-

nancy has apparently not been evaluated statistically for their entire study (which was carried out in Chicago on infants born from 1928 to 1939).

If the views of Petersen and Mayne can be substantiated by further investigations, there arises the question whether habitus as influenced in utero (either by long-range events such as periods of solar turbulence alternating with decreased sun spot activity, or by short-range cosmic events such as changes in temperature and barometer pressure) will be followed by a corresponding trend in body proportions later in life.

Probing into problems of this kind would necessitate consideration of the habitus of the offspring in relation to that of the family type, and this is not possible without measuring several successive generations.

In principle, one particular methodological aspect must be heeded when interpreting those findings which do present seasonal variations, namely, although a statistical examination of such material may not preclude a mathematical correlation between seasonal variability in birth weight and cyclic solar events or meteorological data, the latter should not injudiciously be incriminated as causative factors of the former. In other words, a clear distinction must be maintained between a quantitatively correlatable set of figures (a statistical procedure) and a qualifying conclusion deduced from them (an evaluating process). This line of reasoning is being stressed because the problem of seasonal variation in birth weight ought to imply the possibility of uncorrelated factors which must be accounted for. It would be enough to ignore one single factor of that kind (for example, the influence of diet which may be operative in affecting birth weight) and a correlation between hypothetical factors of an entirely different order (solar phenomena or atmospheric fluctuations) and birth weight variabilities could accidentally yield a semblance of statistical validity. However, calculations of that sort, if used to characterize a causal relationship, can become not only inconclusive but may serve to propound debatable conclusions.

Therefore, one must be cautious with assertions that a demonstration of seasonal differences in birth weights and their statistical relation to solar and terrestrial data prove a prenatal modification of genetic trends by such environmental influences as sun spot turbulence and weather conditions. By inadvertently linking that which appears to be a mathematical relationship with a biological conjecture the investigator may miss the point which he set out to ascertain.

To sum up, statistical procedures which tend to reveal correlations more or less carefully established, must be clearly and sharply distinguished from the demonstrations of causal relationships. A correlation however carefully and thoroughly grounded can never be completely freed of the charge of coincidence. Considerations of probability can not be admitted side by side into a discussion of causal relationships because of the exclusive character of causal thought procedure, whereas probalistic statements always permit of alternatives.

These remarks are intended neither to prove nor refute the ideas of Petersen and Mayne: "Modification of the condition of the maternal body fluids and tissues in which the early development of the embryo takes place leads to the realization of the importance therein implied in modifying genetic trends during the early and very critical stages of development"; and again: "The environmental impacts at the approximate time of conception can modify the physical characteristics of the newborn."

A confusion of terms is evident here. "Genetic" implies that which is inherited. If these trends are to be modified, then it must be shown secularly over a period of many generations. If, on the other hand, by modification of genetic trend is meant change in one individual cycle, then at least two generations of unitary origin must be studied.

Petersen and Mayne have used only cross-sectional measurements in connection with the thesis which the title of their paper indicates; and in my opinion their investigation on seasonal variations in birth weight has not clarified the en-

vironment-heredity problem, for all the reasons that have been demonstrated.

Perhaps all the issues under question can be approached best by studying groups of experimental animals whose genetic lines and environmental conditions can be determined and controlled. To what degree the eventual results can be translated into human terms, is, of course, another question.

THE SMALL BIRTH WEIGHT OF THE NEGRO

Bakwin ('22) brought out the fact that the birth weights of Negroes born in New York, in 1930–1931 were definitely below those of Whites born in the same city and in the same period of time.[1] My findings (table 2) do not contradict those of Bakwin. The question then arises: is the smaller size of the Negro infant a racial characteristic?

In order to come nearer to a solution of this problem, several considerations must be weighed:

1. Is the uterus of the expectant Negro mother of the same average size as in the white woman at the same stage of pregnancy? Has the obstetrical measurement (the height of the fundus) which is used to determine the state of duration of pregnancy, the same validity for Negroes and Whites? Is it good or bad practice to apply one and the same physiologic-anatomical standard to both races? The extent of the prenatal vertical expansion of the womb (and the size of the womb as an index for the duration of pregnancy) is, as a rule, interpreted on the basis of measurements which were obtained on Whites. Though it may sound phantastic, it is not improbable that these traditional standards may have to be revised in behalf of the colored expectant mother.

2. Since birth weights increase up to the sixth pregnancy and decrease thereafter (for references see the bibliography in the publication by Bakwin and Bakwin, '34), a comparative racial study ought to parallel weights of first-borns of one race

[1] T. F. Riggs made a similar observation in Baltimore in 1904, according to Bakwin and Bakwin ('34, p. 619).

TABLE 2

Average weight in kilograms of infants by 90-day intervals up to 2 years of age.

AGE IN DAYS	WHITES							NEGROES				
	Woodbury 1918–'19				Marmor 1935-'36			Woodbury 1918-'19		Michelson 1935–'36		
	Gen. population		N. Y. C. population		N. Y. C. population			Gen. population		N. Y. C. population		
	No.	*Mean*	*No.*	*Mean*	*No.*	*Mean*	*Incr.*	*No.*	*Mean*	*No.*	*Mean*	*Incr.*
					Male							
Birth					150	3.5				480	3.3	
1– 89	3780	5.1	1826	4.7	64	5.0	1.6	203	4.6	1085	4.1	.9
90–179	5498	6.9	2027	6.6	115	7.3	2.2	231	6.6	553 [1]	6.7	2.5
180–269	5509	8.2	1600	8.0	110	8.9	1.6	173	7.6	350 [1]	8.2	1.5
270–359	5512	9.1	1273	8.9	71	10.3	1.3	146	8.4	210	9.4	1.1
360–449	4220	9.8	1063	9.6	36	10.9	.6	101	9.0	120	10.1	.7
450–539	3822	10.4	856	10.3	23	11.8	.8	93	9.9	74	11.1	.9
540–629	3666	11.1	729	11.0	17	13.5	1.7	108	10.4	39	11.5	.4
630–719	3826	11.6	664	11.6	13	13.7	.2	102	11.1	12	11.7	.1
					Female							
Birth					120	3.3				449	3.1	
1– 89	3534	4.8	1723	4.4	64	4.6	1.3	201	4.3	1138	3.9	.8
90–179	5327	6.4	1937	6.1	117	6.4	1.7	254	6.1	652 [1]	6.2	2.2
180–269	5389	7.7	1495	7.5	97	8.2	1.8	179	7.8	407 [1]	7.6	1.4
270–359	5243	8.5	1251	8.3	58	9.8	1.6	167	7.9	212	8.7	1.1
360–449	3985	9.2	1075	9.1	37	10.5	.6	122	8.7	135	9.6	.8
450–539	3749	9.8	805	9.7	14	11.2	.6	123	9.3	72	10.4	.8
540–629	3690	10.5	719	10.4	7	11.4	.2	108	9.8	32	11.3	.8
630–719	3563	11.0	694	11.0	8	12.4	.9	92	10.7	13	11.0	.3

[1] Interval is 90–174 days; 175–269 days.

with weights of first-borns of the other race (as Bakwin and others did); and in the same manner, second-born, third-born children, etc., must be treated, each group by itself. However, this procedure, in order to be conclusive, should not be confined to live-born children only. Abortions, miscarriages, and stillbirths must be included in the count when the numerical order of a pregnancy is made. So far, a survey along these lines has not been possible.

3. The probability of a high incidence of immature births among Negroes, due to environmental causes, must be kept in mind when conducting a comparative racial study on birth weights. Unfortunately, we were not able to obtain material on this aspect of the present study.

4. Social factors have to be considered. The American Negro represents an underprivileged socio-economic class. A well-to-do population will excell in stature over the poor. First-born as well as later-born infants from a poverty-stricken environment will have smaller birth-weights than those derived from more favorable environment (Bakwin and Bakwin, '34, pp. 617, 624).

5. There are additional social issues which may influence a survey on birth weights of a race.

The ratio of first-born children is higher among younger than older mothers. In a youthful group of mothers there will be a greater proportion of children of light birth weights than among mothers of a more advanced age. Therefore, the distribution of the age of the mothers whose children are studied may indirectly influence the average birthweight computed in a given survey. In this connection Tandy ('37) writes as follows: "Of Negro mothers,[2] 23% were under 20 years of age, as compared with 11% of the white mothers. 55% of the mothers of Negro infants were under 25 years of age, as compared with 41% of the mothers of white infants."

The fact that motherhood occurs among Negroes at an earlier age than among Whites, is further illustrated by a

[2] This was a national survey of 249,706 Negro mothers and 1,844,446 White mothers.

more recent, though smaller, inquiry made in Birmingham and Jefferson County, Alabama, in 1940. Of 887 Negro mothers 41.8% were under 20 years of age, and of 355 white mothers 25% were under 20 years of age.

6. Since the Negro population is poorer than the white, there also arises the question about the number of children in a family in relation to social condition and to the weight at birth. As a rule, there are more first-born children among the well-to-do, more later-born among the poor. A higher proportion of later-born children among the Negroes should result theoretically in a larger number of high birth weights. However one must also consider the decline in birth weights beginning with the seventh pregnancy (cf. Bakwin and Bakwin, '34, pp. 616, 625).

All the above mentioned points are enumerated here for the mere purpose of showing the limitation of data when they are collected from a single point of view. Many different aspects must be balanced when correlating material dealing with a study of birth weights as a possible clue to racial differences. This criticism applies as well to may own data already referred to in table 2 in which the birth weights are not separated according to the criteria just mentioned, due to the fact that the necessary information was lacking. New-born infants of Whites and Negroes are here juxtaposed without any further differentiation, and therefore the results of the comparison are of limited value. However, the lighter birth weight of the Negro new-borns as compared with white new-borns seems to be an unchallenged fact, at present.

SECULAR INCREASE IN WEIGHT AMONG CHILDREN

A comparison of the data contained in table 2 with those given in the section on stature shows that these two measures behave very much alike in infants up to 2 years of age. In general, children of the 1935–1936 series are heavier, as well as taller than those measured in 1918–1919. Similarly, Negro children of 1935–1936 are heavier than white children of New

York City measured in 1918–1919. Also, the white children are heavier than the Negro children of the same generation; this applies to 1918–1919 as well as to 1935–1936.

It may be mentioned here that in 1927 weight of boys from the Home of Hebrew Infants collected by Boas ('27) showed that the infants from 5 to 33 months were lighter than the general American white population (Woodbury). From 34 to 62 months, the Hebrew children exceeded the general population. This must be attributed to the fact that in the earlier months the Hebrew children were still suffering from the effects of poor home environment. After having been in the care of the institution for a short period they caught up and passed the average of the general population. A comparison of the first 2 years with the Negro material of 1935 to 1936 shows that the Negro children under the care of the Department of Health, New York City, exceeded the Hebrew children of 1927.

Weights obtained in the years 1935–1936 by Dr. Nellie Marmor from white infants brought up on the same diet as the Negro series from the Department of Health clinics yield the highest values. These children belong to the lower middle class whose parents are better to do than those of the Hebrew and Negro infants. (It was mentioned before that these infants of mixed white descent are also taller than those measured in 1919 by Woodbury.) The maximal weight values of Dr. Marmor's series may be accounted for, first, by the tendency to increase in stature among the white population concommittant with the improvement of the socio-economic status; secondly, by the additional factor of a scientific dietary regime as advocated by the Department of Health of New York City. Thirdly, an acceleration in growth, irrespective of the future final stature, must be kept in mind since one may expect larger weights in children at the time of their accelerated growth. This consideration applies to all the series measured during the more recent period.

THE WEIGHT INCREMENT

Comparing the increment pattern for the white series of Dr. Marmor with that of the Negro series from the Harlem clinics, a marked similarity is noticeable (table 2). Apparently we are dealing here with an analogous tempo of growth in infants of both races. Moreover, it is probable that the same dietary regime may have been causative in effecting a synchronous acceleration in growth among both contemporary populations.

THE INCIDENCE OF RICKETS

In 1936, in conjunction with Dr. Herbert R. Edwards, Director of the Bureau of Tuberculosis, Department of Health, New York City, some Negro infants of the Harlem Clinics were studied by Dr. Jacque M. Lewis from the point of view of rickets. There were few cases of rickets detected, about 2%. The author was given the privilege of examining about 1000 roentgenograms of the hands of Negro children previously studied by Dr. Lewis, and can confirm his findings. While the elimination of rickets by the administered vitamin is a well known fact, its possible responsibility for an excess of growth is still a matter of research, and I reiterate that I am not prepared to render any opinion on any single factor as to its decisive effect on the rhythm of growth.

SUMMARY AND CONCLUSIONS

1. The average birth weight of Negroes born in New York City was one and the same for the different seasons of the year.

In view of the absence of seasonal variations in the birth weights, a solar influence on the unborn, via the expectant mother appeared to be improbable in the series studied.

2. The birth weight of Negroes is smaller than that of Whites. This corroborates the findings of other investigators.

3. Negro infants who have been under the dietary regime of the Department of Health, New York City, showed an increase in weight (and stature) as compared with correspond-

ing age groups measured two decades prior (by R. M. Woodbury). It is probable that the increase found in the later born series is due to the environmental factors. The higher weights (and statures) of the supervised groups may be the result of accelerated growth.

4. The increment pattern for weight is very similar for Whites and Negroes brought up on the same dietary regime. This may be deduced from the follow-up material embracing the period from birth to the second year of life.

5. A survey on rickets undertaken in 1935 by the Department of Health, New York City, disclosed that this deficiency disease had been reduced to about 2%.

LITERATURE CITED

Study of Records of Cases Discharged from Maternity Clinics in Birmingham and Jefferson County for 1940. p. 3. (Compiled by the Division of Child Hygiene and Public Health Nursing).

abels, H. 1926 Weight at birth and vitamins, according to publications from years 1923–1925. Arch. f. Kindern, vol. 78, p. 187.

Adersen, H. 1899 Nord. Med. Ark., N. F., vol. 10, p. 24.

Bakwin, H. 1932 The Negro infant. Human Biology, vol. 4, pp. 1–33.

Bakwin, H., and R. M. Bakwin 1929 Seasonal variations in the weight loss of new-borns. Am. J. Obstet, and Gynec., vol. 18, p. 863.

——— 1934 Body build in infants. V. Anthropometry in the new-born. Human Biol., vol. 6, pp. 612–626.

Boas, Franz 1927 Eruption of deciduous teeth among Hebrew infants. J. Dent. Res., vol. 7, no. 3, pp. 245–253.

Brenton, H. 1922 Climate and race as factors influencing the weight of the newborn. Am. J. Phys. Anthrop., vol. 5, pp. 237–249.

Hanson, J. H. 1913 Meddel f. Anthrop. Kom. Copenhagen.

Hellmuth, K. 1928 Sind jahreszeitliche Schwankungen der Geburtsgewichte statistisch nachweisbar? Ztschr. f. Geburtsh. u. Gynäk., vol. 93, pp. 147–166.

Li, T. A. 1936 Seasonal variation of birth weight of newborn. J. Pediat., vol. 8, pp. 459–469.

Petersen, Wm. F., and Alvin Mayne 1943 Cytoplasmic modifications of genetic trends. J. Am. Med. Assoc., vol. 121, pp. 929–930. (Also reprint with additions, 32 pp.)

Tandy, Elizabeth G. 1937 Infant and maternal mortality among Negroes. U. S. Department of Labor, Children's Bureau, Publication no. 243, Washington, D. C., 34 pp.

Woodbury, R. M. 1921 Statures and weights of children under 6 years of age. U. S. Department of Labor, Community Child Welfare Series, no. 3, Children's Bureau Publ. no. 87, Washington, D. C., 117 pp.

THE M,N TYPES OF CHINESE FROM CANTON

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There is a particular interest attaching to any studies of the M and N blood factors in Mongolian populations. Most of the studies on Europeans have revealed frequencies of N only slightly lower than those of M; in the Australian aborigines the frequencies of N are much higher than those of M (Birdsell and Boyd, '40); but the American Indians, whether North or South, seem to have quite low percentages of type N (Boyd, '39, '43). The best studied Mongoloid population in Asia, the Japanese, on the other hand, do not generally present N values significantly lower than those of Europeans (Boyd, '39). This at once raises the problem of how the Indians got their low N. It might be thought that Mongols in general will be found to have low values of N, for the N in Japan might have been raised by mixture with the Ainu, who, according to Kubo ('36), possess moderately high N (31.9%), with correspondingly lower M. In fact, Birdsell and Boyd ('40) ventured to suggest that the present M,N frequencies of these various populations indicate the previous existence in Asia of a north to south gradient of N, which would perhaps imply that the northern and more Mongoloid end had values of N well below the European range. This could possibly be reflected in the frequencies possessed by certain of the present-day inhabitants of Eastern Asia. Birdsell and Boyd pointed out the importance of filling in the present enormous gaps in our information regarding the serological constitution of these populations, particularly in the direction of further M,N studies on the Chinese.

There are a number of Chinese in Boston who, except for the students, seem to be nearly all from Canton. It appeared worth while therefore to try to determine the distribution of the M,N types in this population, since there is, so far as we know, only one M,N series from China in the literature (Ride, '35), and present political conditions make it unlikely that we can expect in the near future to investigate the Cantonese and other populations in situ.

Through the coöperation of local clinics and Chinese physicians, we were enabled to test in the course of 3 years bloods from 101 individuals who said[1] they were from Canton. The results of the blood group determinations are presented in table 1.

TABLE 1

Blood groups and types of Chinese from Canton.

NUMBER TESTED	PER CENT OF TYPE			PER CENT OF GROUP			
(v)	M	MN	N	O	A	B	AB
101	38.6	45.5	15.8	45.5	29.7	18.8	5.9

$m = \overline{M} + \overline{MN}/2 = 0.614$, $n = \overline{N} + \overline{MN}/2 = 0.386$. $D = 1 - (\sqrt{\overline{M}} + \sqrt{\overline{N}}) = -0.019$, $\sigma D = 0.5/\sqrt{V} = 0.050$, $D/\sigma = 0.39$.

The series is very small, but it will be noted that the value of N, interestingly enough, is even lower than the percentage found in Hong Kong by Ride (18.2%). This figure is still of course a good deal higher than the values of 4–9% thus far found for American Indians, but it, together with Ride's figure, could be taken to suggest that the Chinese may have somewhat lower N than the Europeans and Japanese, which would be in line with the previous existence of the postulated Mongoloid or proto-Mongoloid groups of low N from whom the American Indians were ultimately derived.

[1] We realize that some of our subjects may not have been from the city of Canton itself, as it seems that Chinese from any part of the province of Kwantung often claim they are from Canton. In this matter, as also in the question of possible duplications in the series, we have had to rely on assurances of our local intermediaries.

It is perhaps worthy of mention here that Fabricius-Hansen ('39, '40) found extremely low values of N in the Greenland Eskimo. Aside from these, and the American Indian results, the lowest values yet reported for N are those of Boyd and Boyd ('38), Kayssi, Boyd and Boyd ('38), and Macfarlane ('38) for certain Arabs of the Syrian and 'Iraq deserts. These authors also found other tribes of Arabs, however, with values of N nearly as high as those reported by Ride for the Chinese of Hong Kong. The values of N found by Sewall ('39) in the pure Eskimo of Labrador and Baffin Island, though lower than in Europeans, are distinctly higher than those of the Greenland Eskimo. It thus seems clear that ethnic groups apparently racially related can have M and N distributions which differ significantly. It is probably worth pointing out again the possible role of isolation (Boyd, '40) in setting up such differences.

The A, B results for our series do not present anything of particular interest. The percentage of B we find is rather lower than that reported by Dormanns ('29) for Canton, but not so different from that of a group of "Cantonese" tested by Yang in Darien ('29). Considering the small size of our sample, the agreement must be considered satisfactory.

We are indebted to Dr. H. Lois Kramer and Dr. Ensang W. Cheng for their kind assistance in this work.

SUMMARY

Results of M,N and blood grouping tests on 101 Chinese from Canton are presented. The percentage of N found is rather lower than is usual in European or Japanese populations, and may possibly support the idea that groups of Mongoloids exist, or at one time existed, having distinctly low values of N, which might explain the low values of N thus far always found for the American Indians.

LITERATURE CITED

BIRDSELL, J. B., AND W. C. BOYD 1940 Blood groups in the Australian aborigines. Am. J. Phys. Anthrop., vol. 27, p. 69.

BOYD, W. C. 1939 Blood groups. Tabulae Biologicae, vol. 17, part 2, p. 113.

——— 1940 Critique of methods of classfying mankind. Am. J. Phys. Anthrop., vol. 27, p. 333.

——— 1943 Blood groups of South American Indians. Handbook of South American Indians. Bureau Am. Ethnology. (In press.)

BOYD, W. C., AND L. G. BOYD 1938 The blood groups of the Rwala Bedouin. J. Immunol., vol. 34, p. 441.

DORMANNS, E. A. 1929 Erwiderung auf vorstehende Kritik meiner Arbeit durch Herrn Dr. B. Liang. Münch. med. Wsch., Bd. 76, S. 1467.

FABRICIUS-HANSEN, V. 1939 Blood groups and MN-types of Eskimos in east Greenland. J. Immunol., vol. 36, p. 523.

——— 1940 Blood groups and MN-types of Eskimos. II. (District of Julianhaab, West Greenland. J. Immunol., vol. 38, p. 405.

KAYSSI, A. I., W. C. BOYD AND L. G. BOYD 1938 Blood groups of the Bedouin near Baghdad. Am. J. Phys. Anthrop., vol. 23, p. 295.

KUBO, T. 1936 On the agglutinogens M and N of the Ainu. J. Immunol., vol. 30, p. 287.

MACFARLANE, J. 1938 Cited in Boyd 1939.

RIDE, L. 1935 Hetero-haemagglutination studies amongst Hong Kong Chinese. Caduceus, vol. 14, p. 227.

SEWALL, K. W. 1939 Blood, taste, digital hair and color of eyes in eastern Eskimo. Am. J. Phys. Anthrop., vol. 25, p. 93.

STEFFAN, P. 1932 Handbuch der Blutgruppenkunde. Munich.

YANG, F.-M. 1929 Cited in Steffan 1932.

REVIEWS

THE HUMAN HAND. By CHARLOTTE WOLFF. Preface by William Stevenson, Oxford University. Alfred A. Knopf, New York, xvii + 198 + vi pp., 24 pl., 1943. ($3.00.)

This book presents in its treatment of a small part of the human body, the psychologist's dream of a physical index to the personality of the individual. It aims to provide from a study of the hand a scientific method of testing temperament and character. Used in the interpretation are certain anatomical features and physical qualities: form of the hand, palmar eminences, nails, flexion creases, demato-glyphics, color, flexibility, temperature.

The theory which allows Doctor Wolff to establish her psychology of the hand is an elaboration of ideas held by C. G. Carus and N. Vaschide. The premises are: the hand, the chief instrument of touch, plays an important role in "conducting into the brain the bodily sensations and emotions which go with them;" representations of the hand are over the entire cerebral cortex which, with the medulla oblongata and thalamus, influences the hand. This member reflects every single emotion experienced by the individual. The author thus sees in the hand a "seismograph of emotional reactions."

In addition to studies of hands of normal individuals, Doctor Wolff analyzed hand prints of mental defectives and schizophrenics, of delinquent boys and of monkeys and apes. From correlations of features of the hand with the disease, the physical constitution and the temperament, Doctor Wolff devised her method of interpreting the " psychology of the hand." Specific psychological traits are assignable to the various features and qualities of the hand. Examination of hands alone or the analysis of hand prints enables Doctor Wolff to construct the personality portrait of the subject.

There are six basic classes of hands, each characterized by definite anatomical and psychological traits. Pure examples of these six types are rare. Twelve mixed types are described, but many more are possible. Also considered are bilateral differences. The features of the left hand show "our primary make-up or what we are and the right what we have become."

The interested reader and student is encouraged to acquire the technical knowledge of hand psychology, but the successful practitioner of the art must be endowed with special powers of intuition.

To the matter-of-fact biologist the reasoning upon which the theory of Doctor Wolff's hand psychology is based may appear specious. It is possible, however, that there is more substance in the psychologic aspects of the interpretations, backed as they are by an extensive experience and the intuitive qualities demanded in the pursuit of palm reading.

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LA ANTROPOLOGÍA FÍSICA EN MÉXICO Y CENTRO-AMERICA. ESTADÍSTICAS, BIBLIOGRAFÍA Y MAPAS DE DISTRIBUCIÓN DE CARACTERES SOMÁTICOS. By JUAN COMAS. Publ. Inst. Panam. Geogr. e Hist., no. 68, 1943, 131 pp. with 19 folding maps.

This publication brings together in concise form probably all the measurements that have been taken on groups of twenty-five or more living Mexican Indians. All the data on each measurement and index — including tribal name, number of individuals of each sex, mean for each sex, and author — are assembled in one table according to a north-south geographical arrangement. The scanty data from Central America are listed separately. Folding maps at the back of the volume show the localities where the various groups were measured and the geographical distributions of some of the more important measurements and indices. And finally there is a comprehensive bibliography covering 47 pages.

The purpose of this work is stated in the introduction to be no more than the orderly presentation of the available data that may serve as a basis for organizing future investigations along these lines. In keeping with this aim there is no discussion of the geographical distributions or the variations reported within a tribe. It is difficult to understand how the author could restrain himself from commenting on these points. Perhaps had he committed himself here he would have seen the necessity for including measures of variability where available in the sources. Also, he might have emphasized the temporal differences represented by the samples. Thus, for instance, there are four stature samples of Tarascans, two measured by Hrdlička and Starr at the close of the last century and two by Gómez Robleda 40 years later. Between the means of two of these temporally separate samples there is a difference of 3 cm. Is this difference due to sampling or to technique?

Inevitably in a compilation of this sort some figures obviously reflecting differences in technique are included. Two samples of the Mixtecs are reported with tragion-vertex heights differing in the

mean by 2 cm. The diameter frontal minimum of the Mixtecs and Mayas also differ in the mean by 2 cm. Unless some explanation is given, such large differences necessarily force the reader to go back to the sources and thus partly defeat the purpose of the compilation.

In spite of these limitations this publication should serve its purpose and be very useful for reference.

T. D. STEWART.

THE CONFLICT BETWEEN THE CALIFORNIA INDIAN AND WHITE CIVILIZATION. I. THE INDIAN VERSUS THE SPANISH MISSION. BY S. F. COOK. Ibero-Americana, no. 21, 1943, 194 pp.

SAME. II. THE PHYSICAL AND DEMOGRAPHIC REACTION OF THE NON-MISSION INDIANS IN COLONIAL AND PROVINCIAL CALIFORNIA. BY S. F. COOK. Ibero-Americana, no. 22, 1943, 55 pp.

SAME. III. THE AMERICAN INVASION, 1848–1870. BY S. F. COOK. Ibero-Americana, no. 23, 1943, 115 pp.

Probably nowhere in the New World have the circumstances been more favorable for the preservation of records pertaining to the biological and cultural conflict between Indians and Whites than in California. This is due in part to the fact that most of the early contacts were with missionaries who recorded their activities in considerable detail; and in part to the rapid replacement of the missionaries by the hoards of Americans constituting the "gold rush" (1849), of which there is also a fair historical record. The sum and substance of these records, as invariably resulted from such conflicts, is "the profound diminution in numbers suffered by the natives." In the present studies, therefore, Doctor Cook has used the population decline as "the point of origin from which any discussion of causative factors or subsidiary biological relationships must proceed."

As a first step in his analysis — noteworthy for its biological viewpoint — Doctor Cook reviews Professor Kroeber's figures for aboriginal California population and concludes that the total should be about 7% higher than the latter's estimate. Assuming, then, that the population within the mission sphere was 133,500 in 1770, he arrives at the figure 98,000 for the Indian population at the close of the mission period (1832). From then on the decline was steady until about 1870 when it is estimated to have been about 20,000. "A leveling-off process has been apparent in the last two generations. . . ."

This population decline is analyzed mainly in terms of disease, nutrition, sex delinquency and military casualties. Disease accounts for about 60% of the decline; war for about 9 to 12%. The effect of the other causes cannot of course be evaluated so exactly, because they operate on birth rate as well as on death rate. "On the whole . . . the conflict of the native with the settlers from the United States was characterized by far greater violence than the conflict with the invaders from Latin America." Doctor Cook explains this variation in the intensity of the conflict, comparing Spanish-Indian and American-Indian relationships, as follows:

Both branches of the white race arrived on the Pacific Coast with a heritage of long experience with the Indian: both had developed a well-formulated mental attitude and a definite policy with respect to the natives. But these attitudes and policies were conditioned by the widely differing pioneering and colonial experience of the two branches in the preceding centuries. Both Anglo-Saxons and Spanish had pursued an avowed course of exploitation of New World resources. The Spanish, however, had systematically availed themselves of human resources, whereas the English had tapped only material wealth. Whatever the causes of the divergence, by the nineteenth century the Ibero-Amercians consistently followed the procedure of utilizing the natives and incorporating them in their social and economic structure, whereas the Anglo-Americans rigidly excluded them from their own social order. It followed, therefore, that in opening up California the Spanish system undertook as far as possible to employ the Indians, even by force, in useful pursuits. This in turn meant that the aboriginal race was an economic asset and as such was to be conserved. Destruction of individual life occurred only when and if the Indian actively resisted the process of amalgamation or definitely failed to conform to the conqueror's scheme of existence. Wholesale slaughter or annihilation was definitely undesirable.

The Anglo-American system, on the other hand, had no place for the Indian. If the latter could of his own initiative find subsistence within its framework, there was a priori nothing to prevent such adjustment. But if there was any conflict whatsoever with the system, the native was to be eliminated ruthlessly, either by outright extermination or the slower method of segregation in ghetto-like reservations. Accompanying this economic difference was another divergence of great social significance. The Spanish colonial system always envisaged the retention of the native as the basis of the population and simultaneously encouraged racial mixture. The result was naturally widespread hybridization, especially among the lower classes. Thorough and complete mestization, as in some parts of Spanish America, would have resulted in the disappearance of the California Indian as a pure line strain but would not have destroyed his race or eliminated it as a factor in the body politic. Nor would it necessarily have involved long and bloody physical conflict during the period of racial reorganization. The American civilization, on the contrary, viewed miscegenation with the greatest antipathy and relegated the mestizo, or half-breed, to the same status as his Indian parent. Consequently, no blood bond could ever become established which would mitigate the indifference and contempt with which the Indians were regarded. (III, pp. 4–5).

Far from criticising these studies, I should like to recommend them to everyone interested in racial biology. They are readable, as the above quotation shows, and most of the tabulation is relegated to appendices.

T .D. STEWART.

NOTES

PERSONNEL

Dr. W. Montague Cobb, Professor of Anatomy at Howard University, spent the months of July and August respectively at Western Reserve University, Cleveland, and Washington University, St. Louis, in continuation of a study of ageing in the adult human skeleton based on the collections in those institutions.

Dr. Charles E. Snow, Associate Professor of Anthropology at the University of Kentucky spent a week at the beginning of August at the U. S. National Museum measuring the skeletal remains from Indian Knoll, Ohio County, Kentucky. The site from which C. B. Moore recovered this material in 1916 has recently been thoroughly explored by the University of Kentucky with WPA assistance and has yielded a large number of well preserved skeletons.

Dr. Mildred Trotter, Associate Professor of Anatomy at Washington University Medical School, spent the week of August 30th at Western Reserve University examining the sacra of the Todd skeletal collection. Dr. Trotter is at present directing a cooperative investigation of the bony sacrum and dura mater by members of the departments of anatomy and obstetrics and gynecology which is financed by the U. S. Public Health Service. The data provided by this study besides having direct clinical application in connection with the new method of continuous caudal anesthesia in childbirth, also will have anthropological importance.

ANNUAL BIBLIOGRAPHY

Plans have been made to include in the last number of each new series volume of the Journal a classified bibliography covering recent and current references in physical anthropology and related aspects of human biology. North, Central and South American literature will be covered as completely as possible, but that from over-seas necessarily will be limited to the items reaching this country.

In order to distribute the burden of compiling the references, the Editor has asked a member of the editorial board, W. M. Krogman, who has had considerable experience along this line, to assume charge.

Doctor Krogman, in turn, has invited the following group to assist him: Robert Braidwood, W. M. Cobb, Juan Comas, Howard Meredith, M. F. Ashley Montagu, Isaac Schour, Carl Seltzer, Morris Steggerda, T. D. Stewart, and Mildred Trotter. It should be emphasized, however, that the help of the entire Association will be needed to make the project succeed.

The bibliography in volume 1 will cover the period January 1, 1942 to June 1, 1943. Thereafter, it is proposed that the bibliographies will run from mid-year to mid-year and in this way will be only 6 months behind.

The current bibliography must be in the Editor's hands on or before November 1, 1943. This means that Doctor Krogman must have all pertinent data by October 15, 1943 at the very latest. Therefore, in order to make it as complete as possible in the limited time left, everyone is urged to send any references that have come to his attention (preferably on individual cards), together with suggestions, comments, and advice, to Doctor Krogman at the University of Chicago. The utmost care should be used in verifying and copying references, for part of the value of a bibliography depends upon its accuracy.

EXPERIMENTATION IN PHYSICAL ANTHROPOLOGY

The article, An Experiment bearing on the Problems of Physical Anthropology, by Washburn and Detwiler, in vol. 1, no. 2, of the new series of this Journal presents a view point which will be encouraging to the younger generation. For this reason and because I am conducting an experiment bearing on problems in physical anthropology, I would like to support the philosophy expressed in their paper.

A brief explanation of my work may help to clarify this position. Observations on the Terry Collection of skeletal material in the Washington University Department of Anatomy have raised many questions regarding the causes of certain biological features encountered, among them, the effects of exercise on lipping at joint margins, the development of crests at muscle attachments, and the effects of exercise on the shape of growing bone. Two years ago, when a study of the literature revealed conflicting opinions and data, it was decided to study some of these questions experimentally, using well-known, in-bred strains of mice as subjects. Male mice have been selected, and set to work at the age of 6 weeks on a tread-mill which compels them to run a certain distance in a given time daily, for the remainder of their lives. Other mice of the same genotype are put into the same machine and live under identical conditions as the workers, except they are deprived of all exercise for their life-span. The joints of

these mice are being compared with one another, and with a third series from mice that live in ordinary breeding cages. It is hoped that these studies will be completed and published in spite of handicaps raised by the war, and that as a result interpretation of what we see in human material will rest on sounder foundations than at present.

After a recent meeting of the American Association of Anatomists the criticism was overheard that the work reported was not anatomy, but physiology, biochemistry, and experimental embryology. There is the possibility that a similar objection may be offered to Doctors Washburn and Detwiler; that a study on amblystoma does not concern physical anthropology. However, the view presented by these authors, that work in anthropology has just begun when a morphological condition has been accurately described and a theory formed to explain it, opens new fields; indeed it refutes the opinion often expressed by colleagues in other branches of science that physical anthropology and gross anatomy are decadent. Certainly we should test our theories by all the biological laws which can apply to anthropology, and by experimentation if it is possible.

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RACIAL DIFFERENCES IN THE COLON IN NATIVES OF BOLIVIA

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The length of the whole intestine is known to show wide individual and racial variations. These differences are not proportional throughout the whole bowel, but may be more or less limited to one segment. The widest variations are seen in the sigmoid colon. Because of the racial differences of this part of the bowel, Duval and Gatellier ('34) reached the conclusion that this is an intestinal loop in full morphological evolution with a tendency toward a small loop with short mesentery adjacent to the left part of the pelvis. Other types represent stages of evolution; those that are large and mobile are the fetal and infantile types, and occur in primitive races.

In Sucre, Bolivia, cases of very long intestine are frequent and come to the attention of doctors and laymen because of the most common complication of this anomaly, namely, volvulus. This extra long colon has been interpreted in various manners, but especially as being acquired through the prolonged chewing of the leaves of the coca and the ingestion of a diet rich in cellulose. However, I have shown (Wenger, '43) that the great length of the colon is a peculiarity of the Indians, although it is not limited to the full-blood Indians, being just as frequent in Mestizos, and inherited perhaps as a dominant characteristic. It is the purpose of this paper therefore to give an idea of the average dimensions of the sigmoid colon and its appendages, as well as of the rest of the bowel, in this part of Bolivia, and to show the deviations of these viscera from the general anatomical norms.

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MATERIAL AND METHOD

The bodies of eighty-nine adults were studied. No selection of cases was made; they represent a cross section of the material coming to the Institute of Pathological Anatomy, which receives its cases from a general hospital. Because of the composition of the indigent population of Bolivia all the subjects except five Whites, were Indians or Mestizos. The observations were made during the course of routine autopsies. In each case first the situation of the sigmoid colon and its relations to the other abdominal organs were determined; next the details of the mesosigmoid (size, line of insertion, fossa intersigmoidea) were ascertained; and finally each segment of the bowel was dissected out and measured.

RESULTS

Dimensions. The average length of the sigmoid colon in natives of Bolivia was 74.8 cm. This is considerably more than the length stated by European authors; e.g. Jonnesco ('12) gives 59 cm. The increase in the case of the Bolivians is due solely to the greater development of the pelvic colon — that portion between the inner border of the psoas muscle and the third sacral vertebra — which on the average was 64.5 cm. long. The iliac portion — that between the inner border of the psoas and the crest of the ilium — was normal in size and showed but little variation in length. The longest sigmoid colon measured 115 cm.; other cases measured 110 cm. (2), 108 cm. (1), and 105 cm. (2). The shortest sigmoid colons were 37 cm. and 40 cm. in length. Other segments of the bowel had the following average lengths: Rest of the colon (without rectum), 105.8 cm.; large intestine, 197 cm.; small intestine (without duodenum), 688 cm.

It could be confirmed that there are slight variations between the two sexes in the length of the sigmoid colon (78.9 cm. in the male and 72.7 cm. in the female). The figures for the different racial groups were: 76.1 cm. for Indians, 75.8 cm. for Mestizos, and 55.4 cm. for Whites (only five cases).

The length of the intestine bore no relation to stature, which generally is low among Indians and Mestizos: The average height of the cadavers was 153.9 cm. (about 5 feet).

The circumference of the colon was measured after longitudinal section of the bowel. By this method postmortem distention by gases was excluded. The differences between the results of measuring before and after section range up to 30%. The average circumference of the sigmoid colon was 12 cm., and the rest of the colon 14 cm. Even when adding 30% to these figures the circumference is not greater than that usually stated for Europeans.

Situation and relations. The sigmoid colon in forty-eight cases was situated in the minor or major pelvic cavity (i.e., did not pass above the line of the crest of the ilium) and in forty-one cases it was found in the abdominal cavity. In cases where the sigmoid colon had been displaced temporarily from the pelvis by other organs (bladder, uterus, etc.) the obstacle first was removed and afterwards the situation re-considered. Thus, the abdominal location of the sigmoid colon in the forty-one cases mentioned above may be regarded as its permanent situation.

When the sigmoid colon was found in the minor pelvis it filled the cavity rather completely. Only in five cases was it limited to the left side of the pelvis, with an average length of but 43 cm. But when the sigmoid colon was situated in the major pelvis (iliac situation), or when it had an abdominal situation, it was found frequently occupying the flank, especially on the left. Of the sixty-four cases of iliac or abdominal situations it was found thirty times near the mid-line, twenty-three times on the left, and eleven times on the right side.

In the iliac and abdominal situations there may exist relations to many other organs. Of these relations the most important necessarily is that with the small bowel. Loops of the latter may be arranged mostly behind, or before, the sigmoid colon; or approximately equal parts of them may lie before and behind the sigmoid. Thus, three types of situation of the sigmoid can be distinguished in relation to the small

bowel: Anterior, intermediate, and posterior. Of the sixty-four cases of abdominal or iliac situations, thirty-nine were anterior, thirteen were intermediate and twelve were posterior. In the intermediate and posterior situations usually the loops of the small bowel reached the anterior department of the abdomen by turning around the left side of the sigmoid, and in the places where the two crossed each other the lumen appeared frequently to be narrowed, especially when meteorism happened to be present.

If the sigmoid colon is very long — and in this series this was the case very frequently — it may be in touch with any intraperitoneal organ. In the cases where it reached the upper quadrants of the abdomen it crossed in the anterior position the transverse colon ventrally and reached the anterior wall of the stomach, the liver, the spleen, or even the left phenic cupola; in the posterior position it elevated strongly the mesocolon transversum.

Torsion. Long sigmoid colons frequently exhibited torsion This was observed in a third of the cases with abdominal position, and in a fifth of the cases with iliac position. The torsion may be of the type ''recto-posterior'' (clockwise), in which the last part of the sigmoid colon comes to lie posteriorly, or ''recto-anterior'' (counter-clockwise). The former was far more frequent. The places where the two parts of the sigmoid colon crossed each other were frequently considerably narrowed, in a way similar to the crosses with the small bowel.

Iliac colon. The course of the iliac colon was in most cases straight, or it formed a slight angle or arch pointing downwards or laterally. In fifteen of the forty-one cases of abdominal situation the bowel did not descend to the inner border of the psoas muscle, because in some part of the iliac fossa it had turned upwards abruptly to take its course through the abdominal cavity. I have called this shape the ''reflex form'' of the iliac colon.

Although it is generally supposed that the iliac colon has no free mesentery, I found an apparent mesentery in 54% of

the cases. In half of these it occurred only in the inferior part, and in the other half in the entire iliac colon. To determine if such a mesocolon did or did not exist, the bowel was handled always very carefully and without any traction. The existence of a mesocolon did not depend upon the length of the sigmoid colon or its situation; it was definitely more frequent in old age than in the young; and also in cases of cachexia. It appeared that in most cases this was really not a true mesentery, but that it was parietal peritoneum (primary or secondary) mobilized from the abdominal wall by atrophy of the subserous adipose tissue. This "mesentery" is generally from 2 to 5 cm. wide, and it may be even as much as 7 cm. On the other hand, in one case in which the left colon had failed to coalesce, there was a free mesentery 10 cm. wide in both the descending and iliac portions.

Mesosigmoid. A free mesentery in the second or pelvic portion of the sigmoid colon was found in all cases with the exception of those which presented extensive adhesions. Its average width was 15.6 cm., varying from 10 to 23 cm. Its width was related to the length of the pelvic colon: In the cases with a short pelvic colon (less than 50 cm.) the average width of the mesosigmoid was 12.5 cm. and in those with a large pelvic colon (more than 70 cm.) the mesosigmoid was 18.2 cm. In men the mesentery of the pelvic colon was slightly wider (16.2 cm.) than in women (15.1 cm.). Also, it was wider in the abdominal (17.7 cm.) than in the pelvic position (13.9 cm.). Yet it must not be concluded from these averages that a long pelvic colon always has a wide mesentery: Two of the cases with a mesentery of but 10 cm. had a pelvic colon 60 cm. long.

Upon extending the fan formed by the pelvic colon and its mesentery, it is possible to measure in the latter two generally distinct diameters: One near the parietal peritoneum, between the first and last parts of the pelvic colon ("proximal length"), and another more distant from the parietal peritoneum ("distal length"). The former was shorter than the latter in sixty-four cases, both were equal in eleven, and in

only four cases was the proximal length larger than the distal. Thus, the name given to the sigmoid colon by some French authors — "omega loop" — seems to be adequate for most cases. On the average, the proximal length was 9.7 cm., the distal length 12.9 cm. In cases of abdominal situation the distal length was slightly smaller (12.6 cm.) than in the cases of pelvic situation (13.2 cm.); in those where the pelvic colon did not leave the minor pelvis it was even longer (14.3 cm.).

The insertion of the mesosigmoid forms an angle opening downward. One of the sides of this angle is the remnant of the insertion of the primitive mesentery, whereas the other is the line of coalescence. The vertex of this angle was found to be usually at the height of the fifth or of the inferior part of the fourth lumbar vertebra, but sometimes as high as the upper part of the fourth vertebra. Such a high insertion was associated generally with a great length of the sigmoid colon. From the vertex the line of insertion of the primitive mesentery descended in forty cases in the mid-line, in thirty-four cases to the left of the mid-line (1 to 4 cm.), and in eight cases to the right.

Fossa intersigmoidea. A fossa intersigmoidea was found in one half of the cases examined and was from 0.2 to 7 cm. deep. I noticed that frequently the entrance of the fossa was not placed in the vertex of the angle formed by the line of insertion of the mesosigmoid, but higher up in the mesentery, and as much as 7 cm. distant from its insertion. This high position of the fossa was very frequently combined with a free mesentery of the iliac colon: Of twenty-three cases with a free iliac mesentery and with the fossa intersigmoidea present, nineteen showed a high position of the latter.

COMMENT

The great length of the sigmoid colon in these cases, relative to current textbook descriptions (Jonnesco, '12; Tandler, '28; Testut and Latarjet, '34), seems to be a well established fact, both as concerns the average and the cases of maximum and minimum size. This seems to be due to the racial factor,

the subjects having a preponderance of Indian blood. It is worth mentioning that Tapia de la Maza ('40) found in Chile a similar length of the sigmoid colon (80.4 cm.). The rest of the colon and the small intestine have normal length. However, a comparison of cases in this series with relatively long sigmoid colons and those that are short makes it clear that the other intestinal segments show small but significant differences in length between these two groups. So the general view is confirmed that the sigmoid colon, especially its pelvic portion, is the most variable, but not the only variable part, of the bowel.

The fact that nearly half of the cases showed the sigmoid colon in the abdominal situation is another deviation from standard anatomical descriptions, which state that the regular place of the sigmoid colon is in the pelvic cavity. The abdominal situation seems to occur in less than 10%, according to European descriptions (Jonnesco, '12; Tandler, '28; Testut and Latarjet, '34). The cases of pelvic and abdominal situations showed considerably different averages in length (66.4 and 84.6 cm.). That the length of the sigmoid colon cannot be the only factor which determines its situation is proved by the fact that Tapia de la Maza had only 10% of abdominal situations notwithstanding his great average length of the sigmoid colon. I think that there are at least two more factors of importance: The caliber of the sigmoid colon and the shape of the mesosigmoid. In cases of pelvic situation the average circumference of the sigmoid colon was 9.9 cm., and in those of abdominal situation it was 15 cm. The shape of the mesosigmoid was wider and shorter in cases of abdominal situation. This shape does not permit the colon to form several secondary loops, so that there is only one loop of the sigmoid colon which necessarily has to place itself in the abdominal cavity when it is long and voluminous.

The frequent abdominal situation of the sigmoid colon certainly permits movements on a large scale. This mobility favors the formation of volvulus; but it must be recalled that torsion frequently exists without interference with function.

Two sorts of torsion may be distinguished: Torsion of the sigmoid colon around the long axis of its mesentery, and torsion of the small bowel around the sigmoid colon. The narrowings found in the places where the two parts of the bowel cross certainly do not present an obstacle during life to the passage of the intestinal contents, but they show that some mutual pressure and tension is exercised and this may play an important role in the production of ileus in cases of volvulus.

The long voluminous sigmoid colon necessarily must exert by its weight a continuous tension on the mesentery, and indirectly on the parietal peritoneum. I think this is the explanation of why in this series there was a free iliac mesentery in 54% and not in 10% as generally stated: The parietal peritoneum, especially when the subserous adipose tissue has undergone atrophy, as in old age or cachexia, yields finally to the forces which pull it towards the abdominal cavity so that it forms a fold similar to a mesentery, but naturally very different in its genetic constitution, for instead of two primitive serosa leaflets it contains four. The same may occur in the large mesentery of the pelvic colon, where the level of the original insertion is frequently marked by the fossa intersigmoidea, which represents a defect in the coalescence of the primitive mesentery with the parietal peritoneum. When the fossa is distant as far as 7 cm. from the line of insertion, one is forced to suppose that this 7 cm. of apparent mesentery in reality is parietal peritoneum pulled away from its original place. This is confirmed by the frequent association of a free iliac mesentery with a fossa distant from the line of insertion of the mesentery. It is possible that by this traction the "vertex" of the line of insertion may appear higher up than it was originally (4th lumbar vertebra).

To summarize the differences found between cases of very large and normal sigmoid colon, table 1 has been elaborated, based on the findings in the eighteen cases which had a sigmoid colon of 90 cm. or longer, and on the fifteen cases which had one of 60 cm. or shorter. From this table it can be seen

that the extraordinary length of the sigmoid colon is due nearly exclusively to the length of its pelvic portion; that all the rest of the bowel takes part in the enlargement, although to a minor degree; that the same is true both for the circumference and the length; that great length is relatively more

TABLE 1

Comparison of cases with longest and shortest sigmoid colons.

		SIGMOID COLONS 90 CM. OR LESS IN LT.	SIGMOID COLONS 60 CM. OR LESS IN LT.
Number of cases		18	15
Average length of sigmoid colon		99.4 cm.	51.4 cm.
Average length of pelvic portion of sigmoid		88.9 cm.	40.8 cm.
Average length of iliac portion of sigmoid		12.0 cm.	10.6 cm.
Average length of rest of colon (without rectum)		112.1 cm.	96.1 cm.
Average length of small intestine (without duodenum)		731 cm.	627 cm.
Circumference of sigmoid colon		17.1 cm.	9.8 cm.
Circumference of rest of colon		14.3 cm.	12.2 cm.
Distribution by sex	male	9	5
	female	9	10
Distribution by race	White	0	3
	Mestizo	13	8
	Indian	5	4
Average age		53.2 years	45.7 years
Average body height		153.6 cm.	153.0 cm.
Distribution by situation of "pelvic" colon	pelvic	3	14
	abdominal	15	1
Frequency of torsion	present	7	1
	absent	11	14
Average width of mesentery		19.1 cm.	12.5 cm.
Average length of mesentery		14.4 cm.	12.0 cm.

frequent in the male than in the female; that it is found in Indians and Mestizos, but not in Whites; that it is found at an average age slightly higher than in cases of normal length; that body height has practically no relation to the length of the colon; that the most frequent situation of a long colon is the abdominal, and of the normal colon the pelvic cavity;

that in the cases of long colon torsion (without volvulus) is rather common; and that the mesentery of the long sigmoid colon is wider and, in relation to the width, shorter.

SUMMARY

In Sucre, Bolivia, among Indians and Mestizos the sigmoid colon is extraordinarily long. This is a racial peculiarity. A study of eighty-nine non-selected autopsy cases gave the following results:

The average length of the sigmoid colon was 74.8 cm., its length varying from 37 to 115 cm. In all cases the enlargement was due to the length of the pelvic and not of the iliac portion of the sigmoid colon. The circumference was normal.

The rest of the bowel was normal in size, but longer in the cases of huge sigmoid colon than in those of normal size. So it is confirmed that, as to its length, the sigmoid colon is the most inconstant part of the bowel.

The sigmoid colon was found in nearly half of the cases in the abdominal cavity, and not in the pelvic cavity alone. It seems to occupy this position when both its length and circumference are great, and furthermore when the mesentery is wide but not very long.

The heavy sigmoid colon exerts a constant tension on the parietal peritoneum, by which the latter is forced to take part in the formation of the mesentery, especially when the subserous adipose tissue has atrophied. This is shown by the frequency (50%) of an apparently free mesentery in the iliac portion of the sigmoid colon; by the location of the fossa intersigmoidea high up in the mesentery, distant from the line of its insertion; and by the frequent association of both peculiarities in many cases.

LITERATURE CITED

DUVAL, P. AND J. GATELLIER 1934 Tratado de patología quirúrgica. Third Spanish ed. transl. from the fifth French by E. Ondiviela Garriga and Manuel Portaceli y Ortells, Barcelona.

JONNESCO, T. 1912 Tube digestif. In "Traité d'anatomie humaine" by Poirier and Charpy, 3rd ed., vol. 4, pt. 1, pp. 50–439.

Tandler, J. 1928 Tratado de anatomía sistematica. Spanish ed., Barcelona.

Tapia de la Maza, M. 1940 Colon iliopélvico y algunos consideraciones sobre el resto del intestino en nuestro medio. Arch. Chilenos Morfol., vol 3, pp. 225–236.

Testut, L., and A. Laterjet 1934 Tratado de anatomía humana. Spanish ed., Barcelona.

Wenger, F. 1943 Las dimensiones del colon in Sucre, Bolivia. Rev. Sudam. Morfol., vol. 1, pp. 83–97.

VARIATION OF THE DIASTEMATA IN THE DENTITION OF THE ANTHROPOID APES AND ITS SIGNIFICANCE FOR THE ORIGIN OF MAN

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ONE FIGURE

In the anthropoid apes there is usually a space between the lateral incisor and the canine tooth on each side of the upper jaw. This space is formed by the premaxillary bone and hence may be called the premaxillary space or diastema; in this way it may be distinguished from the precanine space which is often present in the lower jaw. As is well known, in man both the premaxillary and precanine spaces are not usually present; when, occasionally, the premaxillary space is seen in man it is quite inconsiderable (Montagu, '35, '36, '40), and is quite certainly incorrectly interpreted as evidence of the reappearance of a former ancestral condition, as an atavism. The concept of atavism is entirely based on a misconception of the nature of certain develpomental conditions (Montagu, '38). There is always a certain amount of continuous variation in the spaces of the dental series in man, and the occasional limiting of this variability to the space between the maxillary lateral incisor and canine is to be expected and regarded as part of the normal range of variation which occurs in these spaces.

It is not a legitimate assumption to make that because the apes exhibit a premaxillary space man must have been derived from a stock the members of which exhibited a similar space in the upper jaws. The word "stock" is very loosely

used more often than not to imply a group of animals all of whom were alike, undoubtedly members of the same genus, usually members of the same species, and too often silently taken for granted that they were of the same variety. Some writers, when they speak of the "common stock" from which the anthropoids and man are assumed to be descended seem to have in mind an Adam and Eve-like pair of anthropoid-like ancestors from which all the great apes, at least, and all men have, somewhat divergently descended, or else they give the impression of having in mind that these were descended from the same variety of early apes. It is doubtful whether any reputable student could be found to maintain such a view seriously, nevertheless such students are, at times, capable of writing as if they believed in such a view. Most students would agree that the evidence of the anthropoid fossil record (Gregory and Hellman, '26, 39; Gregory, Hellman and Lewis, '38) strongly suggests that the Hominidae as a whole and the different genera of great apes in particular each descended from different species and probably different genera of apes all of whom were members of the same stock or family in the classificatory sense. Such a view is polygenic as opposed to monogenic. The evidence derived from the facts set out in this paper inductively tends to support the former as against the latter view.

The present study had its origin in the attempt to find an answer to the following simple questions: In the Hominidae, extinct and living, a premaxillary diastema is absent, the Hominidae, therefore must have inherited this condition from some remote ancestor in whom it was already fully established. How did this condition come about in the proto-Hominid ancestors of man? Did the canines of the upper and lower jaws undergo reduction simultaneously with reduction of the premaxillary and precanine diastemata, or did these changes occur independently of one another? Are the conditions among the extinct and existing anthropomorpha capable of throwing any light on these questions? What do the facts indicate con-

cerning the origin of man and his relation to the existing anthropomorpha?

The answers to these questions, based on a study of the available materials, are set out in what follows.

THE ANCESTRAL STOCK OF THE HOMINIDAE

The fossil apes of the genera Dryopithecus and Sivapithecus are generally agreed to be the closest known forms to that presumed common "stem" from which man on the one hand and the existing anthropoids on the other are believed to have originated. The Dryopithecus-Sivapithecus stock may even represent that common ancestral "stem." Unfortunately, little is known of the upper jaws of these two genera of fossil apes. Of the various Indian and European species of Dryopithecus we know that the canine teeth were of modest size compared to those of the existing apes, though D. frickae probably possessed rather large canines not unlike those of the male orang. There can be very little doubt that in Dryopithecus an appreciable premaxillary diastema was present. In Sivapithecus sivalensis we know the canines of both the upper and lower jaws, these are of modest size but still considerably larger than the homologous tooth in man. The character of the mandibular canines in Sivapithecus almost certainly implies the existence of a premaxillary diastema. In Hellman's reconstruction of the upper jaw such a diastema, measuring some 4.0 mm., is present. In Sivapithecus orientalis the upper canines are rather tusk-like in form, and there can be no question that in this species, too, a substantial premaxillary diastema was present. Such evidence as is available for the other species of Dryopithecus and Sivapithecus indicates that a premaxillary diastema was present in all of them.

It is to be concluded, then, that if man and the existing anthropoids were derived from the Dryopithecus-Sivapithecus stock, man must subsequently have lost the premaxillary diastema while the anthropoids underwent an increase in its size in relation, presumably, to the increase in the size of the canines of both jaws. If this is so, then it seems clear that

whatever the relationship of man and the anthropoids may be to the Dryopithecus-Sivapithecus stock man probably originated from some descendant of that stock much later than did the immediate ancestors of the anthropoids. This conclusion seems to be dictated by the evidence for the reason that since no Miocene fossil apes are known in which a premaxillary diastema was absent man must have originated from some later anthropomorphous stock in which such a diastema was already absent. On the other hand the existing anthropoids possess a premaxillary diastema, which is not, when relative body size is taken into consideration, significantly larger than that which existed in these Miocene apes. Indeed, the dentition and morphological relationships of the mandible in Sivapithecus, and what the maxilla may from the former be assumed to have looked like, bears a remarkable resemblance to the same featurs in the chimpanzee. The suggestion that man appeared much later than the anthropoids is an idea which is in agreement with all the available evidence. The evidence that they have the same or a similar remote common ancestry in the Dryopithecus-Sivapithecus stock is based primarily upon an anlysis of dental characters, but such as it is the evidence for that remote common ancestry seems strong.

The question may be asked whether it is not possible that a mutation or series of mutations occurred early in the history of man's divergence from the common stock which led to the reduction in the size of the canines and the obliteration of the premaxillary diastema, thus making it possible that the ancestral proto-hominids and the anthropoids underwent a more or less contemporaneous divergence, or let us say, split from the common stem at more or less the same time?

This is quite possible, but in the present state of our knowledge this is a question which cannot be satisfactorily answered. The evidence, however, seems to be against the implied suggestion that the hominid character of the upper jaws and canines may have originated quite early, for we do not encounter these traits until Pleistocene times are reached.

In the Australopithecine fossil apes, Australopithecus, Plesianthropus, and Paranthropus the canines approach very closely to the hominid type and a premaxillary diastema is absent. It is extremely unlikely that these very man-like apes, one or other of which may be the direct ancestor of man, could also have been ancestral to the modern great apes. It is hardly conceivable, even without an appeal to the law of irreversibility of evolution, that a stock which had lost the premaxillary-canine characters of the Dryopithecus-Sivapithecus group, could then give rise to a type represented by the great apes in which the canines are very large and the premaxillary diastema of considerable size.

Certainly mutation did not take a holiday in the case of the apes; unquestionably the modern apes are the result of, among other things, a history of mutation, but the evidence suggests that with respect to the premaxillary diastema they have preserved, and even taken further, a very old ancestral trait. The modern apes could therefore be conceived to be descendant from a line independent of that which led to the Australopithecinae, and possibly through the latter to man. This line of reasoning does not, however, exclude the possibility of an ape-like form with a premaxillary diastema being immediately ancestral to the line of man.

The recent discovery, by Dr. G. H. R. von Koenigswald ('42), of the greater part of the upper jaw of an adult Pithecanthropus erectus, and of the lower jaw of another adult member of the same species, throws considerable light upon this question.

The upper jaw of Pithecanthropus IV exhibits a very small canine which projects below the level of the other upper teeth for no more than some 3.5 mm. In the lower jaw of Pithecanthropus B no canine is present but the canine socket has been preserved and this suggests that the lower canine was as small as, if not smaller than, the upper one. Since this tooth is relatively no larger than the canine of the Australopithecine apes it would be expected that a premaxillary diastema was absent in Pithecanthropus, but this is, in fact, not so.

In Pithecanthropus IV there is a considerable premaxillary diastema between the canine and the lateral incisor. This diastema measures 6.2 mm. This is exactly the average size of the diastema in the adult male gorilla (four specimens), (fig. 1).

Fig. 1 Upper jaw of Pithecanthropus IV, and lower jaw of Pithecanthropus B. Courtesy of the Carnegie Institution of Washington.

The presence of a gorilla-like premaxillary diastema in this ape-like man in association with a set of small canines is a fact as unexpected as it is important. In the first place it would dispose of the assumption that a small mandibular canine is necessarily associated with absence of a premaxillary diastema. It has generally been considered that the loss of the canine diastemata was, in the evolution of man, associated with the reduction in the size of the canine teeth, that the diastemata either underwent reduction concomittantly with

the reduction in the size of the canines, or that the reduction of the diastemata followed upon the reduction in the size of these teeth. In the second place it makes very clear the fact that in the evolution of man the canine teeth, in at least one early hominid group, underwent reduction first, and that it took another step in evolution to bring about the reduction of the canine diastemata, and thus to produce a further shortening of the jaws.[1]

Whether these changes were brought about by single mutations or by the accumulation of a number of small mutations it is, at present, not possible to say. We have, in the reduction of the canine teeth and in the persistence of the premaxillary diastemata, in Pithecanthropus, a beautiful illustration of the character of the changes which occurred in the early progenitors of man.

The conclusion that the premaxillary diastemata served the function of giving lodgement to and permitting the free excursion of the mandibular canines, the tips of which projected into the series of the upper teeth, is supported by the conditions in Pithecanthropus. Here we have small mandibular canines which scarcely projected above the occlusal level, nevertheless the premaxillary space is preserved. This, to the present writer at any rate, suggests that the premaxillary space underwent contraction as a second mutation following upon an inherited tendency towards reduction in the size of the canines by mutation. Since the upper canines are situated and develop in the maxilla, while the premaxillary space is formed by premaxilla, it may at first be difficult to see how reduction in the size of the maxillary or mandibular canines can have affected the premaxillary bone. The change in the premaxilla was almost certainly brought about by mutation. Mutations, it is generally assumed, occur by chance. "Chance" is merely another name for unpredictability or the statement of the limtied measureability of certain phenomena; this we

[1] It should be pointed out here that the presence of a premaxillary diastema in Pithecanthropus renders this genus very much more primitive, in this respect, than Sinanthropus with which some students have sought to identify it.

may, indeed we must, accept as being so, but in the present connection it may be submitted that the facts look very much as if it were not a purely accidental juxtaposition of several mutations which first led to the reduction in the size of the canines and subsequently to the reduction of the premaxillary space. It would seem rather that the reduction of the size of the canines was in some way connected with the reduction of the premaxillary space. Embryogenetically or morphogenetically an explanation could be attempted as to the manner in which this might have been brought about (Waddington, '40; Needham, '42), but this would, in the present state of our knowledge, be for the most part speculative and would take us too far afield, we must therefore be satisfied to do our best with the interpretation of the gross facts in an unavoidably gross manner.

Evidence accumulated by the present writer (Montagu, '35, '36, '40), showed that the region of the premaxilla between the canine and lateral incisor teeth is a very unstable one, an instability reflected in the frequency of cleft palate, missing, dwarfed, rotated, crowded or supernumerary lateral incisors. The evidence suggested thot this was simply the continuing process of an "evolutionary trend." It is highly probable that in Pithecanthropus such a trend was already at work. But we have only one upper jaw to go upon, and that has a very large premaxillary diastema; no other hominoid group has a premaxillary diastema. We are therefore forced to go to the existing anthropoids in order to discover what kind of variation, if any, is to be found among them with reference to the premaxillary diastemata in particular, and any other diastemata in general. If, in the great apes, we find that the variation is of such a nature as to render it very probable that a similar variability characterized Pithecanthropus it may help us to explain the step or steps by which the hominoid condition was attained.

THE DIASTAMATA IN THE GREAT APES

The term diastema, as used in this paper, means the distance between the proximal surfaces of two teeth at the level of the

dento-enamel junction. In all the apes there are generally two diastemata present in the upper jaw, these are (1) the right and left premaxillary diastemata situated between the canine and lateral incisor teeth, and formed practically entirely by the premaxilla, (2) the right and left pre-canine diastemata situated between the canine and lateral incisor teeth of the mandible, and (3) the right and left post-canine diastemata situated between the first premolar and the canine teeth of the mandible.

These diastemata were measured in a total of 256 anthropoid crania, specifically 18 gibbons, 69 orangs, 83 chimpanzees, and 86 gorillas. Sex was determined whenever possible, and the material was classified into the following groups:

Infant: In which the deciduous teeth had either partially or completely erupted, but in which no permanent tooth was present.

Young: In which any of the permanent teeth had erupted with the exception of the third molar, and the basilar suture was unobliterated.

Adult: In which all the permanent teeth had erupted and the basilar suture was either partially or wholly-obliterated.

In the following tables of measurements an "—" indicates that the maxilla or mandible was either missing or not in a condition to measure accurately.

In reading the following tables it should be remembered that there is a certain amount of variability in the sizes of the skulls measured in each age group, and that this size difference is to a certain extent, very probably, regularly related to the size of the various diastemata between the teeth.

For permission to examine and report upon these skulls I am obliged to the following gentlemen and their institutions: Dr. Remington Kellogg, Division of Mammals, U. S. National Museum, Washington, D. C.; Dr. W. K. Gregory, Department of Human and Comparative Anatomy, American Museum of Natural History, New York; Mr. Harold Coolidge, Department of Mammals, Museum of Comparative Zoology, Harvard College, Cambridge, Massachusetts; Mr. Cadwalader and Mr.

J. A. G. Rehn of the Academy of Natural Sciences, Philadelphia; Dr. Macfarland of the Museum of the College of Physicians, Philadelphia. To the Carnegie Institution of Washington I am grateful for permission to reproduce Dr. Koenigswald's figure of Pithecanthropus IV and B upper and lower jaws.

The first skull alone listed in table 1 is infantine, the remainder are young. This series of six skulls is far too small to warrant any generalizations, and the figures as they stand are self-explanatory. The pattern or size of the various diastemata is that which is presented by all the anthropoid apes. The largest diastema is the premaxillary, the next largest is usually the precanine, and the smallest the postcanine.

TABLE 1

HYLOBATES

Infant-Young

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 4	?	2.5	2.5	1.8	1.8	0.0	0.0
A.N.S.P. 5262	?	2.5	3.0	1.3	1.3	1.2	1.2
A.N.S.P. 6670	?	4.4	3.7	0.0	0.3	0.0	0.0
A.N.S.P. 12178	?	2.1	2.1	0.0	0.0	0.0	0.0
M.C.Z.C. 12745	♂	1.8	1.6	1.9	2.3	0.0	0.0
M.C.Z.C. 22275	?	1.0	0.8	0.0	0.3	0.0	0.0
Mean	?	2.4	2.3	0.9	1.0	0.2	0.2

TABLE 2

HYLOBATES

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 3	♀	2.8	3.0	0.0	0.0	2.0	2.0
A.N.S.P. 12803	♂	2.0	3.0	0.0	0.0	0.0	0.0
M.C.Z.C. 12742	♂	1.8	1.2	0.6	0.8	0.0	0.0
M.C.Z.C 12746	♀	1.2	1.2	0.0	0.0	0.0	0.0
M.C.Z.C. 23121	?	1.3	1.0	0.8	1.0	0.0	0.0
M.C.Z.C. 30383	?	1.6	1.4	2.4	1.6	1.5	1.6
M.C.Z.C. 77867	?	1.8	1.5	1.6	1.5	1.7	1.8
Mean	?	1.8	1.8	0.8	0.7	0.7	0.8

Again, seven skulls are hardly sufficient to permit of any generalizations, but if the perception of a trend may be allowed it may be observed that in the adult the precanine series of diastemata, both of the upper and lower jaws, are smaller than they are in the infant-young group, the mandibular postcanine diastemata alone are slightly larger in the adult than they are in the infant-young group. It will also be observed that variability is very low in the adult as compared with the infant-young group. This is almost certainly to be taken as a reflection of the fact that the infant-young group is a growing one, whereas the whole group has reached a static condition in this respect. Similarly the greater size of the diastemata of the precanine series in the former group is to be taken as a reflection of growth factors in preparation for the eruption of the permanent teeth. The significance of the large size of the precanine diastemata is ontogenetic rather than phylogenetic.

TABLE 3

SYMPHALANGUS

Infant

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 6680	?	2.5	2.5	0.0	0.0	0.0	0.0
A.N.S.P. 6681	?	4.4	3.3	0.0	0.0	0.0	0.0
A.N.S.P	♂	5.9	5.8	1.8	2.5	1.8	2.1
A.N.S.P. 20485	♂	5.0	5.0	1.0	1.0	2.0	1.8
M.C.Z.C. 27867	♀	1.8	1.5	1.2	1.4	1.7	1.7
Mean	?	3.9	3.6	0.8	1.0	1.1	1.1

One young skull, not included in table 3, of undetermined sex, (M.C.Z.C. 27831), showed practically no diastemata. The measurements, in the usual order, were 1.3, 1.7, 1.0, 1.4, —, —. Upon comparing the measurements of the diastemata in the five adult Symphalangus skulls with those of the seven Hylobates of the same age group it will be observed that the mean measurements for the premaxillary diastema are alone sig-

nificant, the premaxillary diastema being, as a rule, about twice as large in Symphalangus as in Hylobates. Owing to the smallness of both samples this finding must be accepted with reserve.

TABLE 4

PONGO

Infant

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 2159	?	3.0	3.0	0.0	0.0	0.0	0.0
A.N.S.P. 2160	?	3.3	3.3	—	—	—	—
M.C.Z.C. 5059	?			NO DIASTEMATA			
M.C.Z.C. 5290	?	1.0	0.0	—	—	2.0	1.0
Author's Coll.	?	2.0	3.0	0.0	0.0	3.0	3.0
A.M.N.H. 17110	?	3.5	3.5	0.0	0.0	0.5	0.5
A.M.N.H. 17350	?	4.8	4.8	—	—	—	—
A.M.N.H. 35288	?	5.0	5.0	0.0	1.7	2.1	2.1
A.M.N.H., C.A. 899	♀	4.0	4.0	0.0	0.0	1.0	1.0
Mean	?	3.0	3.0	0.0	0.3	1.2	1.1

It will be observed from table 4 that in the upper and lower jaws of one infant orang skull there were no diastemata present, and that in another (M.C.Z.C. 5290) there were practically no diastemata.

TABLE 5

PONGO

Young

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 2199	♂?	5.5	5.2	1.5	1.5	1.5	1.5
A.N.S.P. 31312	♂	4.0	4.0	0.0	0.0	0.0	0.0
A.N.S.P. 6193	♂	5.8	5.5	2.8	2.8	1.8	0.5
A.N.S.P. 13148	♂	3.0	4.5	7.5	7.8	5.0	4.5
U.S.N.M. 49849	♂	6.0	6.0	4.0	4.0	3.5	3.5
U.S.N.M. 49856	♂	3.5	3.5	3.5	3.5	3.5	3.5
U.S.N.M. 49878	♂	7.0	7.0	4.0	4.0	2.5	2.5
U.S.N.M. 153811	♂	3.5	3.5	0.0	0.0	2.0	2.0
U.S.N.M. 153817	♂?			NO DIASTEMATA			
U.S.N.M. 197665	♂	5.5	5.5	2.0	2.0	2.0	2.0
Author's Coll.	♂?	4.0	4.0	2.3	2.3	1.0	1.0
Mean	♂	4.3	4.4	2.3	2.3	2.1	2.0

In these seven known and four probable male young orang skulls all the diastemata are slightly larger than they are in the infant orang. One skull had no diastemata whatever in either the upper or lower jaws.

TABLE 6

PONGO

Young

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 2171	♀	3.5	3.5	0.0	0.0	0.0	0.0
A.N.S.P. 12191	♀?	NO DIASTEMATA					
A.N.S.P. 12943	♀	6.4	8.3	4.9	5.9	6.0	6.0
A.N.S.P. 12952	♀	10.5	9.3	4.0	4.2	4.3	5.0
A.N.S.P. 13110	♀	6.5	6.5	0.0	0.0	0.0	0.0
U.S.N.M. 49852	♀	10.0	10.0	3.5	3.5	2.0	2.0
U.S.N.M. 49862	♀	7.5	7.5	3.1	3.1	3.2	3.2
U.S.N.M. 145322	♀	4.0	4.0	1.0	1.0	2.5	2.5
A.M.N.H. 18010	♀	NO DIASTEMATA					
M.C.Z.C. 413	♀	3.2	3.2	2.0	2.0	2.0	2.0
Mean	♀	5.2	5.2	1.9	2.0	2.0	2.0

In these seven known and three probable female young orang crania the premaxillary diastemata appear to be slightly larger than they are in the male young orang. In two cases the premaxillary space attains a size of some 10.0 mm. In the male the largest premaxillary diastema recorded attained some 7.0 mm. In two out of the ten female young there were no diastemata of any kind in the upper and lower jaws.

From table 7 it may be observed that in the twenty-two adult orang crania there listed the mean size of the premaxillary diastema is some 6.4 mm., while the remaining diastemata are, as a rule, very small indeed. Variation in the size of the premaxillary diastema is fairly considerable, there being three cases with a space of 1.0 mm. In one case (U.S.N.M. 49859) the postcanine diastemata were almost as large as the premaxillary diastemata. In another case (U.S.N.M. 153818) the

TABLE 7

PONGO

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA Right	Left	MANDIBULAR DIASTEMA Precanine Right	Left	Postcanine Right	Left
A.N.S.P. 2164	♂	3.8	2.0	—	—	—	—
A.N.S.P. 12597	♂	6.0	7.5	3.0	2.0	1.5	1.5
A.N.S.P. 4631	♂	7.8	6.1	0.0	0.0	0.0	0.0
A.N.S.P. 13371	♂	—	—	1.0	1.8	2.4	1.8
C.P.P. 13582.00	♂	5.8	5.9	1.0	1.0	0.0	0.0
M.C.Z.C. 5061 (cast)	♂	7.0	7.0	—	—	—	—
M.C.Z.C. 5211	♂	10.0	10.0	2.0	2.0	3.0	3.0
M.C.Z.C. 6957 (cast)	♂	5.0	5.0	—	—	2.0	2.0
M.C.Z.C. 6958 (cast)	♂	10.0	10.0	—	—	—	—
U.S.N.M. 49850	♂	3.5	3.5	1.0	1.0	2.0	2.0
U.S.N.M. 49853	♂	10.0	10.0	1.5	1.5	1.0	1.0
U.S.N.M. 49855	♂	8.0	9.0	2.5	2.0	3.1	3.4
U.S.N.M. 49859	♂	7.5	8.0	3.1	3.1	7.0	6.0
U.S.N.M. 49860	♂	7.0	7.0	2.0	2.0	1.5	1.5
U.S.N.M. 49864	♂	5.0	5.0	0.0	0.0	2.0	2.0
U.S.N.M. 145319	♂	3.0	3.0	0.0	0.0	0.0	0.0
U.S.N.M. 153806	♂	7.5	6.5	0.0	0.0	1.0	1.0
U.S.N.M. 153807	♂	5.5	6.0	2.0	2.0	2.5	2.5
U.S.N.M. 153810	♂	5.0	5.0	0.0	0.0	1.0	1.0
U.S.N.M. 153818	♂	2.5	2.5	0.0	0.0	0.0	0.0
U.S.N.M. 153823	♂	8.0	8.0	4.0	4.0	3.0	3.0
U.S.N.M. 153824	♂	4.0	4.0	0.0	0.0	1.0	0.0
U.S.N.M. 267325	♂	8.0	7.0	2.0	2.0	2.0	2.0
U.S.N.M. 153833	♂?	—	—	0.0	0.0	2.5	3.0
Mean	♂	6.5	6.3	1.2	1.1	1.8	1.8

premaxillary diastemata measured only 2.5 mm., there being no other diastemata present.

From table 8 it will be seen that in these seventeen adult female orangs the various diastemata are all slightly, though significantly, smaller than in the male adult orang. In three cases there were no diastemata at all, and in one case (U.S.N.M. 153834) there were no premaxillary diastemata, while the remaining diastemata did not exceed 2.0. In one other case (U.S.N.M. 153805) there were practically no diastemata in either the upper or lower jaws. In this series of seventeen adult female orangs, then, we find that in 25% of cases the premaxillary diastemata are completely reduced.

TABLE 8

PONGO

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
U.S.N.M. 49848	♀	9.0	10.0	0.0	0.0	1.0	1.0
U.S.N.M. 49851	♀	9.0	9.0	0.0	0.0	1.0	1.0
U.S.N.M. 49857	♀	7.0	7.0	—	—	—	—
U.S.N.M. 49861	♀	6.8	6.0	0.0	0.0	1.0	1.0
U.S.N.M. 49863	♀	7.0	7.0	3.0	3.0	2.5	2.5
U.S.N.M. 145320	♀	NO DIASTEMATA					
U.S.N.M. 145321W	♀	3.0	3.0	1.0	1.0	1.5	1.5
U.S.N.M. 153805	♀	1.0	1.5	0.0	1.8	0.0	0.0
U.S.N.M. 153808	♀	4.5	4.5	1.0	1.0	2.0	2.0
U.S.N.M. 153812	♀	7.0	6.0	5.0	2.0	0.0	0.0
U.S.N.M. 153819	♀	0.0	0.0	2.0	2.0	2.0	2.0
U.S.N.M. 153822	♀	6.0	5.0	0.0	0.0	0.0	0.0
U.S.N.M. 153823	♀	—	—	0.0	0.0	0.0	0.0
U.S.N.M. 153828	♀	3.0	3.0	0.0	0.0	0.0	0.0
U.S.N.M. 153834	♀	—	—	0.0	0.0	2.0	2.0
U.S.N.M. 197664	♀	—	—	0.0	0.0	0.0	0.0
U.S.N.M. 22149	♀	NO DIASTEMATA					
A.M.N.H., C.A. 898	♀	4.3	4.7	—	0.9	—	1.0
A.M.N.H., C.A. 900	♀	7.0	7.0	5.0	0.0	1.9	1.7
A.M.N.H. 18010	♀	NO DIASTEMATA					
Mean	♀	4.4	4.3	0.6	0.5	0.7	0.7

TABLE 9

PAN

Infant

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 2161	♀	5.9	4.0	3.0	2.0	3.0	3.0
A.N.S.P. 2162	♀	NO DIASTEMATA					
C.P.P. 1660.09	♀	3.8	1.7	1.7	1.8	2.5	2.0
C.P.P. 1660.10	♀	5.9	4.0	3.0	2.0	3.0	3.0
A.M.N.H. 1238	♀	NO DIASTEMATA					
A.M.N.H. 2058	♀	2.0	2.0	0.0	0.0	0.0	0.0
A.M.N.H., C.A. 2412	♂	3.9	3.8	3.0	3.1	0.0	0 0
A.M.N.H. 51210	♀	4.5	4.5	1.0	1.0	0.0	0.0
M.C.Z.C. 9317	♀	2.8	2.8	1.0	1.0	—	—
M.C.Z.C. 9495	♀	3.2	3.2	1.5	1.5	1.5	1.5
M.C.Z.C. 23165	♂	1.0	1.0	0.6	0.6	0.5	0.5
M.C.Z.C. 23166	♀	1.4	1.4	—	3.0	—	—
M.C.Z.C. 37256	♀	3.4	3.4	—	—	—	—
M.C.Z.C. 37257	♀	3.2	3.2	—	—	—	—
Mean	♀	2.5	2.2	1.7	1.1	0.7	0.7

Two of the fourteen infant chimpanzee crania listed in table 9 show no diastemata whatever, and one (M.C.Z.C. 23165) shows practically none. The diastemata in the infant chimpanzee are, as a rule, very small indeed.

TABLE 10

PAN

Young

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 11812	?	2.0	3.0	0.0	0.0	0.0	0.0
A.N.S.P. 12477	♂	2.5	2.1	0.0	0.0	1.7	1.7
A.N.S.P. 12804	♂	—	—	2.5	2.5	3.0	3.7
A.N.S.P. 16979	♀	2.8	2.8	1.0	2.0	1.0	1.5
A.M.N.H., C.A. 499	?	5.0	4.2	—	—	—	—
A.M.N.H. 10276	?	4.0	5.0	0.0	0.0	2.5	1.5
A.M.N.H. 35550	?	1.7	4.5	0.0	2.0	0.0	1.0
A.M.N.H. 51211	♀	1.5	1.8	—	—	—	—
M.C.Z.C. 9316	?	2.5	2.0	—	—	—	—
M.C.Z.C. 17685	♂?	6.3	6.4	4.1	3.0	1.4	4.0
M.C.Z.C. 19188	?	4.2	4.2	2.5	2.4	1.8	1.8
M.C.Z,C. 18189	?	2.4	2.3	3.4	—	1.8	—
M.C.Z.C. 26845	♂?	2.4	3.0	0.5	1.0	—	0.0
M.C.Z.C. 27453	♂?	4.5	4.5	2.7	4.0	1.0	1.1
M.C.Z.C. 34101	?	1.4	2.0	2.7	2.8	—	—
M.C.Z.C. 37259	?	5.7	5.7	—	—	—	—
U.S.N.M. 174708	♂?	5.0	5.0	2.5	2.5	0.0	0.0
U.S.N.M. 176233	?	3.0	3.0	—	—	—	—
U.S.N.M. 176234	?	0.0	0.0	—	—	—	—
U.S.N.M. 176236	♂	0.0	0.0	—	—	—	—
U.S.N.M. 176237	?	3.0	3.0	—	—	—	—
U.S.N.M. 220066	♂	3.5	3.5	2.5	2.5	1.5	1.5
U.S.N.M. 49893	♂	4.0	4.0	0.0	0.0	0.0	0.0
Author's Coll.	?	2.5	2.5	—	—	1.5	1.5
Mean	?	3.0	3.1	1.5	1.6	1.2	1.4

Out of the twenty-four young chimpanzee crania listed in table 10 only two (U.S.N.M. 176234 and 176236) showed complete absence of the premaxillary diastema; there were three cases in which the premaxillary diastema was less than 2.0 mm. in length.

TABLE 11

PAN

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
U.S.N.M. 22065	♂	8.5	8.5	4.5	4.5	2.0	2.0
U.S.N.M. 176228	♂	5.0	5.0	3.0	3.0	2.5	2.5
U.S.N.M. 176230	♂	3.5	3.5	—	—	—	—
U.S.N.M. 176235	♂	1.0	1.5	0.0	0.0	0.0	0.0
U.S.N.M. 176240	♂	6.5	6.5	—	—	—	—
U.S.N.M. 176241	♂	9.0	9.0	—	—	—	—
U.S.N.M. 176242	♂	7.5	7.5	—	—	—	—
U.S.N.M. 176266	♂?	4.5	4.5	—	—	—	—
U.S.N.M. 220327	♂	3.5	3.5	—	—	—	—
M.C.Z.C. 20041	♂	4.7	4.5	3.9	3.9	2.4	2.4
M.C.Z.C. 23163	♂	6.5	6.5	2.4	2.4	2.5	2.5
M.C.Z.C. 23164	♂	4.0	4.0	2.0	2.0	1.0	1.0
M.C.Z.C. 20060	♂	5.5	5.5	2.0	2.0	1.0	2.0
A.M.N.H. 51207	♂	—	6.0	3.0	3.0	2.7	2.7
A.M.N.H. 51376	♂?	7.8	7.8	5.0	4.0	3.0	2.5
A.M.N.H. 51379	♂	5.5	5.5	4.0	2.9	2.3	1.3
A.M.N.H. 51394	♂?	6.5	7.0	2.5	—	2.6	—
Mean	♂	5.2	5.6	3.0	2.8	2.0	1.9

Of the fourteen known and three probable adult male chimpanzee crania listed in table 11, there is one skull (U.S.N.M. 176235) in which the premaxillary diastemata measure 1.0 mm. on the right and 1.5 mm. on the left side, a negligible amount, while there are no other diastemata in the upper and lower jaws. Variability is quite considerable in the dimensions of the premaxillary diastemata.

Of the twenty known, one probable adult female chimpanzee crania, and seven adult chimpanzee crania of unknown sex, one (U.S.N.M. 220063) showed a premaxillary diastema of only 1.0 mm. on the right side, none on the left, and no diastemata in the mandible. For all practical purposes this skull may be regarded as exhibiting no diastemata. It is to be observed that there is no significant difference in the size of the diastemata between the male and female chimpanzee.

TABLE 12

PAN

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
U.S.N.M. 84655	♀	7.5	7.5	4.0	4.0	2.5	2.5
U.S.N.M. 174699	♀	7.0	9.0	2.0	2.5	0.0	0.0
U.S.N.M 174700	♀	4.0	4.0	1.0	1.0	2.0	2.0
U.S.N.M. 174701	♀	6.0	6.0	3.5	3.5	2.0	2.0
U.S.N.M. 174702	♀	8.0	8.0	4.0	4.0	3.0	3.0
U.S.N.M. 174707	♀	5.5	5.5	3.0	3.0	2.0	2.0
U.S.NM. 174710	♀	4.5	5.5	—	—	—	—
U.S.N.M. 176227	?	5.0	5.0	1.0	1.0	2.2	2.5
U.S.N.M. 176229	♀	7.5	7.5	4.0	4.0	2.0	2.0
U.S.N.M. 176238	?	2.5	2.5	—	—	—	—
U.S.N.M. 176239	♀	4.0	4.0	—	—	—	—
U.S.N.M. 220062	♀	6.0	6.0	3.5	3.5	3.0	3.0
U.S.N.M. 220063	♀	1.0	0.0	0.0	0.0	0.0	0.0
U.S.N.M. 220064	♀	6.0	6.0	—	—	—	—
U.S.N.M. 236971	♀	8.5	8.5	4.5	4.5	4.5	4.5
A.M.N.H., C.A. 2874	♀	8.0	7.5	5.7	7.3	3.4	4.0
A.N.S.P. 2155	?	4.5	4.0	0.0	0.0	0.0	0.0
A.N.S.P. 2156	?	4.0	4.0	—	—	—	—
A.N.S.P. 2564	?	3.5	3.5	1.8	1.8	1.8	1.8
M.C.Z.C. 9493	♀	3.2	3.2	1.2	1.6	1.8	0.8
M.C.Z.C. 14916	?	5.8	4.2	1.5	1.5	1.5	0.8
M.C.Z.C. 17702	♀	6.3	7.3	1.7	3.0	1.5	1.5
M.C.Z.C. 23167	♀	6.0	4.0	1.0	1.0	1.0	1.0
M.C.Z.C. 26846	♀	5.0	5.0	3.0	3.0	2.0	2.0
M.C.Z.C. 26847	♀	5.1	5.1	2.5	2.4	1.7	1.8
M.C.Z.C. 26849	♀	6.8	6.8	—	—	—	—
M.C.Z.C. 37260	?	5.8	5.9	—	—	—	—
Author's Coll.	♀?	6.6	6.0	1.0	1.0	1.5	2.4
Mean	♀	5.7	5.6	2.4	2.5	1.9	1.9

TABLE 13

GORILLA

Infant

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
A.N.S.P. 3143	♂	NO DIASTEMATA					
A.N.S.P. 3145	♂	4.0	4.0	—	—	—	—
M.C.Z.C. 9491	♂?	0.8	0.8	1.0	1.0	—	—
A.M N.H. 1457	♂	3.8	3.5	0.0	0.0	0.0	0.0
A.M.N.H. 54328	♂?	4.5	5.0	1.0	1.0	1.5	1.5
A.M.N.H. 22832	♂?	3.5	4.5	—	—	—	—
A.M.N.H. 54084	♂?	5.1	6.8	4.0	4.5	2.5	2.8
U.S.N.M. 241232	♂	3.5	3.5	2.0	2.0	1.5	1.5
Mean	♂	3.1	3.5	1.3	1.3	1.1	1.1

As may be seen from table 13 one (A.N.S.P. 3143) out of the eight infant gorilla crania showed no diastemata whatever, while another (M.C.Z.C. 9491) showed practically none. All crania were of the species gorilla, with the exception of U.S.N.M. 241232, which belonged to the species beringei.

TABLE 14

GORILLA

Young

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
				Precanine		Postcanine	
		Right	Left	Right	Left	Right	Left
U.S.N.M. 176214	♂	3.5	3.5	—	—	—	—
U.S.N.M. 176219	♂	0.0	0.0	—	—	—	—
U.S.N.M. 239884	♂	5.0	5.0	—	—	—	—
U.S.N.M. 252578	♂	6.0	6.0	2.7	2.7	1.0	1.0
M.C.Z.C. 2	♂?	4.7	4.7	3.0	3.0	4.3	2.6
A.M.N.H., C.A. 1473	?	2.0	2.0	0.0	0.0	1.5	1.5
U.S.N.M. 174697	♀	1.0	1.0	—	—	—	—
A.N.S.P. 16983	♀	5.0	5.5	0.0	0.0	0.0	0.0
M.C.Z.C. 37265	♀	2.6	2.6	1.6	1.7	—	1.0
Mean	?	3.3	3.3	1.5	1.5	1.8	1.2

Out of the nine young gorilla crania listed in table 14, one (U.S.N.M. 176219 ♂) showed no premaxillary diastemata, the mandible was missing but it is most probable that it, too, showed no diastemata. In another skull (U.S.N.M. 174697 ♀) the premaxillary diastemata measured no more than 1.0 mm. It is of interest to note that there appears to be no signicant difference in the sizes of the dental diastemata between infant and young gorilla crania.

Among the forty male adult gorilla crania listed in table 15 there is one which has practically no premaxillary diastemata (Harold Coolidge private collection). In this specimen each space measured 0.9 mm. The mandibular diastemata in this specimen, interestingly enough, are of appreciable size. This proves that reduction in the size or absence of the premaxillary spaces does not necessarily imply a correlated reduction in the mandibular spaces. Study of the figures listed in the other

TABLE 15

GORILLA

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA		MANDIBULAR DIASTEMA			
		Right	Left	Right	Left	Right	Left
U.S.N.M. 174712	♂	3.5	3.5	2.0	2.0	1.5	1.5
U.S.N.M. 174713	♂	10.5	10.5	3.5	3.5	2.5	1.5
U.S.N.M 174714	♂	5.7	5.7	1.5	2.3	3.5	3.5
U.S.N.M. 174715	♂	5.0	5.0	3.5	1.5	5.0	4.0
U.S.N.M. 174716	♂	2.5	2.5	0.0	0.0	1.5	1.5
U.S.N.M. 174717	♂	7.0	7.0	3.0	3.0	—	—
U.S.N.M. 174718	♂	3.0	3.0	—	—	—	—
U.S.N.M. 174720	♂	3.0	3.0	0.0	0.0	1.5	1.5
U.S.N.M. 174722	♂	3.5	4.0	0.0	0.0	1.0	1.0
U.S.N.M. 176207	♂	6.5	6.5	1.5	1.5	2.5	2.5
U.S.N.M. 176210	♂	7.0	7.0	5.0	1.0	1.0	2.0
U.S.N.M. 176216	♂	3.5	3.5	0.0	0.0	1.0	1.0
U.S.N.M. 176215	♂	8.0	8.0	0.0	0.0	3.5	3.5
U.S.N.M. 176225	♂	9.5	9.5	3.5	3.0	1.5	1.5
U.S.N.M. 220324	♂	5.0	6.5	3.0	3.5	1.0	1.0
U.S.N.M. 239883	♂	10.0	8.5	5.0	—	0.0	0.0
A.M.N.H., C.A. 500	♂?	—	8.0	2.0	2.0	1.0	1.0
A.M.N.H., C.A. 503	♂?	7.3	7.0	2.0	2.0	2.0	2.0
A.M.N.H., C.A. 504	♂?	4.0	6.0	0.0	0.0	2.1	2.2
A.M.N.H., C.A. 506	♂?	5.0	7.5	1.0	1.0	0.0	0.0
A.M.N.H., C.A. 508	♂?	9.5	—	1.0	1.0	0.0	0.0
A.M.N.H., C.A. 507	♂	5.5	—	2.5	—	2.5	—
A.M.N.H., C.A. 1471	♂	11.5	10.5	4.0	2.3	1.0	0.0
C.P.P. 1155.03	♂	8.4	7.4	4.2	4.7	4.4	4.1
Coolidge pvt. coll.	♂	0.9	0.9	3.0	3.0	4.3	2.6
C.P.P. 1660.105	♂	4.5	3.5	1.0	1.0	0.0	0.0
L.C.E.P. 1	♂	7.0	7.0	1.5	1.5	3.0	3.5
A.N.S.P. 16981	♂	5.0	4.0	1.0	1.0	0.0	1.5
A.N.S.P. 16982	♂	5.1	6.1	0.0	2.0	0.0	0.0
M.C.Z.C. 9587	♂	4.4	4.4	1.8	1.5	2.2	2.8
M.C.Z.C. 20038	♂	6.0	6.0	1.7	1.8	2.3	2.5
M.C.Z.C. 20039	♂	13.9	13.9	1.4	0.0	0.0	0.0
M.C.Z.C. 23160	♂	4.6	5.0	1.6	2.1	2.3	2.5
M.C.Z.C. 23161	♂	4.1	4.1	1.4	0.0	0.0	0.0
M.C.Z.C 23162	♂	7.9	7.9	4.0	2.2	1.6	1.7
M.C.Z.C. 29048	♂	7.7	7.7	2.5	4.0	3.3	0.7
M.C.Z.C. 29049	♂	6.7	5.8	3.5	0.0	0.0	1.5
M.C.Z.C. 37261	♂	10.0	10.0	5.0	4.8	1.0	2.5
M.C.Z.C. 37262	♂	6.6	6.6	1.3	1.1	2.0	2.4
M.C.Z.C. 37263	♂	9.0	8.1	—	—	—	—
Mean	♂	6.3	6.2	2.1	1.7	1.7	1.5

tables in this paper will confirm this fact, although it is, in general, evident that there is a tendency for small premaxillary diastemata to be associated with small mandibular diastemata. Variability is quite marked in the size of the dental diastemata of the adult male gorilla.

TABLE 16

GORILLA

Adult

NUMBER	SEX	PREMAXILLARY DIASTEMA Right	PREMAXILLARY DIASTEMA Left	MANDIBULAR DIASTEMA Precanine Right	MANDIBULAR DIASTEMA Precanine Left	MANDIBULAR DIASTEMA Postcanine Right	MANDIBULAR DIASTEMA Postcanine Left
U.S.N.M 154553	♀	1.5	1.5	0.0	0.0	1.0	1.0
U.S.N.M. 174711	♀	3.0	4.0	1.0	1.0	1.0	1.0
U.S.N.M. 176211	♀?	5.0	4.0	1.5	2.5	0.0	0.0
U.S.N.M. 174698	♀	1.0	3.5	0.0	0.0	0.0	0.0
U.S.N.M. 220060	♀	1.5	1.0	0.0	0.0	0.0	0.0
U.S.N.M. 252575	♀	4.9	4.9	3.0	3.0	0.0	0.0
U.S.N.M. 252577	♀	10.0	11.5	5.0	5.0	1.0	1.0
U.S.N.M. 25276	♀	6.0	6.5	1.5	1.5	1.0	1.0
U.S.N.M. 252579	♀	4.5	5.0	3.0	3.0	0.0	0.0
U.S.N.M. 252581	♀	7.5	7.5	3.0	3.5	0.0	0.0
U.S.N.M. 252582	♀	6.5	6.5	2.5	2.5	1.5	1.5
A.N.S.P. 2154	♀	3.2	3.2	0.0	0.0	2.0	2.0
A.N.S.P. 2157	♀	6.3	7.0	—	—	—	—
A.N.S.P. 2863	♀	3.8	3.5	—	—	—	—
A.N.S.P. 5530	♀	5.0	5.0	2.0	2.0	1.5	1.5
M.C.Z.C. 1	♀	3.8	3.6	1.4	0.9	0.5	0.5
M.C.Z.C. 9311	♀	4.9	4.9	3.2	0.0	1.7	1.7
A.N.S.P. 16984	♀	8.8	11.1	2.1	3.0	3.5	2.8
M.C.Z.R. 9490	♀	—	5.5	—	—	—	—
M.C.Z.C. 9492	♀	3.1	3.1	—	—	—	—
M.C.Z.C. 14750	♀?	5.5	5.5	2.1	—	1.5	1.1
M.C.Z.C. 17684	♀	6.4	6.4	2.5	2.5	2.5	2.2
M.C.Z.C. 20043	♀	5.4	4.8	2.2	2.3	1.6	1.8
M.C.Z.C. 26850	♀	3.0	3.0	1.5	1.5	0.0	0.0
M.C.Z.C. 29047	♀	5.7	5.7	—	1.0	—	—
M.C.Z.C. 37264	♀	7.8	5.7	2.5	1.6	1.7	1.8
M.C.Z.C. 37266	♀	8.9	8.8	—	—	—	—
L.C.E.P. 2	♀	6.0	5.0	2.0	4.0	6.0	2.0
Author's Coll.	♀	3.8	4.0	0.0	0.0	0.0	0.0
Mean	♀	5.1	5.0	1.8	1.8	1.2	1.0

Out of the twenty-nine female adult gorilla crania listed in table 16 there were none with complete absence of the premaxillary diastemata, although there were two cases (U.S.N.M. 154553 and 220060) which showed practically no diastemata in either the upper or lower jaws. In a third example (U.S.N.M. 174698) the premaxillary diastemata measured no more than 1.0 mm. on the right side, but on the left measured 3.5 mm. while there were no diastemata present in the mandible at all. The female as compared with the male adult gorilla shows a significantly larger number of reduced premaxillary diastemata, as well as smaller mandibular

diastemata. All diastemata are significantly smaller in the adult female than in the adult male gorilla.

DISCUSSION

The examination of the dimensions of the various dental diastemata in the four anthropoid apes shows us that these are extremely variable. In the series of eighteen gibbons examined the diastemata are quite small when compared with those found in the other genera of apes, this is, in part, due to the fact that the skull of the gibbons is much smaller than the skull of any of the great apes. In Hylobates the premaxillary diastema is often, and in Symphalangus occasionally, less than 2.0 mm. in length. The series is, however, too small to permit of any definite judgments or comparisons. In the eighteen gibbon crania examined absence of the premaxillary diastemata was not encountered in a single case. Were a larger series of crania to be examined it is possible that some few such cases would be found in the adult group.

In the infant orang one skull or 10.1% was found with no diastemata whatever; since only nine cases were examined this percentage would probably be considerably reduced were a larger series of crania examined. In another skull the premaxillary diastema did not excede 1.0 mm. In eleven young male orangs one skull or 9.0% showed no diastemata. In ten young female orangs two skulls or 20.0% showed no diastemata. The young female orang appears to be altogether more variable in the size of the diastemata than the male. In the male adult orang not one of the twenty-two skulls examined exhibited absence of the premaxillary diastemata, on the other hand the mean measurement for the premaxillary diastema was 6.4 mm. with a range of from 2.5 to 10.0 mm. In the adult female orang the case is very different, for out of seventeen skulls three show no diastemata whatever, while two others probably showed complete absence of all diastemata. In another case the premaxillary diastemata were alone absent, and they were probably absent in one other case, while another skull showed a premaxillary diastema of no more than 1.0 mm.

on the right and 1.5 mm. on the left side. Thus, in this series of seventeen adult female orangs 25.0% showed complete absence of the premaxillary diastemata, while at least 17.6% showed complete absence of all diastemata. Again, the adult female orang is more variable than the adult male orang, the range being from zero to 10.0 mm., the mean of all diastemata being smaller in the female than in the male.

Two out of fourteen chimpanzee crania showed no diastemata, and one showed diastemata not exceeding 1.0 mm. Out of twenty-four young crania two showed no premaxillary diastemata, and in three cases these spaces measured less than 2.00 mm. on each side. In the adult male there was only one out of the fourteen and three probable male crania which showed a premaxillary diastema of less than 2.0 mm. In the adult female there was one case in which the premaxillary diastema measured 1.0 mm. on the right and was absent on the left side, there also being no diastemata in the lower jaw. Variability again appears to be greater in the adult female than in the adult male chimpanzee.

In one out of the eight infant gorilla skulls there was no diastemata, and in another case the premaxillary diastemata did not exceed 0.8 mm. No premaxillary diastema was present in one young male gorilla, and in a female this diastema measured 1.0 mm. The total number of cases examined was nine. Premaxillary diastemata were present in all forty adult male gorillas examined, but in one case these diastemata measured no more than 0.9 mm., the range being 0.9 to 13.9 mm., the mean 6.2 mm. Similarly, in the twenty-nine adult females examined there was no case in which the premaxillary diastemata were absent, but in three cases these diastemata measured less than 2.0 mm.

The results of our findings are summarized in table 17.

In eighteen gibbon crania the premaxillary diastemata were invariably present.

In sixty-nine orang crania the premaxillary diastemata were absent in eight cases or in 11.6% of skulls, including four adults or 5.8% of adults.

In eighty-three chimpanzee crania the premaxillary diastemata were absent in four skulls or 4.8% of the total number for all ages. In one adult female there was a premaxillary diastema of only 1.0 mm. on the right side alone.

In eighty-six gorilla crania there were two cases or 2.5% with no premaxillary diastemata. There were three other cases in which these diastemata may have been absent or measured less than 1.0 mm. In sixty-nine adult gorillas there was only one case in which there was almost complete reduction of the premaxillary diastemata, the space measuring only 0.9 mm. on each side.

TABLE 17

GENUS	NUMBER	AGE	SEX	PRE-MAXILLARY DIASTEMA	MANDIBULAR DIASTEMA		PMX. DIAST. ABSENT IN	ALL DIAST. ABSENT NO.
					Pre-canine	Post-canine		
Hylobates	6	I–Y	?	2.3	0.9	0.2	0	0
Hylobates	7	Ad.	?	1.8	0.7	0.7	0	0
Symphalangus	5	Ad.	?	3.7	0.9	1.1	0	0
Pongo	9	I	?	3.0	0.1	1.1	.	1
Pongo	11	Y	♂	4.3	2.3	2.0	.	1
Pongo	10	Y	♀	5.2	1.9	2.0	.	2
Pongo	22	Ad.	♂	6.4	1.1	1.8	0	0
Pongo	17	Ad.	♀	4.3	0.5	0.7	1	3
Pan	14	I	?	2.3	1.4	0.7	.	2
Pan	24	Y	?	3.0	1.5	1.3	2	0
Pan	17	Ad.	♂	5.4	2.9	1.9	0	0
Pan	28	Ad.	♀	5.6	2.4	1.9	1?	0
Gorilla	8	I	?	3.3	1.3	1.1	1?	1
Gorilla	9	Y	?	3.3	1.5	1.5	1	1?
Gorilla	40	Ad.	♂	6.2	1.9	1.6	1?	0
Gorilla	29	Ad.	♀	5.0	1.8	1.2	0	0

We may conclude then, that while in the infant-young group the premaxillary diastema may occasionally be absent in all three great apes, it is only in the female orang that this diastema is found absent in the adult in about 5.8% of cases. In the adult male orang, and in the adult chimpanzee and gorilla of both sexes it may be very appreciably reduced but it is rarely, if ever, completely absent.

So far as our results go then, it may be concluded that, with the exception of the female adult orang, absence of the premaxillary diastemata does not normally occur in the adult member of the great apes. Hence, absence of the premaxillary diastemata in the Hominidae must be regarded as a character specific to man, specifically distinguishing man from the anthropoids.

Presence of the premaxillary diastemata in the adult African apes and the rarity with which reduction of these diastemata occurs, would suggest that in the chimpanzee and gorilla there has been, as in so many other characters, a considerable degree of specialization. In brief, that the trend in the African apes has been towards increase in size of the premaxillary diastemata.

The study of the character of the diastemata in the dental series of the apes reveals that the variation encountered in them is of a continuous kind, the transitions in the size of the diastemata are minimal and there are no large quantitative or discontinuous gaps (Bateson, 1894; Mayr, '42). The adult apes, with the sole exception of some female orangs, all show the presence of larger or smaller premaxillary diastemata. In the case of the female orang we may look upon the occasional occurrence of non-diastematization as the expression of a purely sexual difference; the genus as a whole is characterized by the presence of appreciable diastemata. Similarly, the occasional presence of non-diastemata in the sub-adult apes may be regarded as due to the operation of dynamic growth factors; such spaces are occasionally seen in the deciduous dentition of young children. The appearance of non-diastematization must, therefore, have been achieved by the establishment of a discontinuous variation, and this, most probably, was brought about by mutation. As Mayr has pointed out, "All the evidence indicates at the present time that the mode of inheritance (chromosomal-Mendelian) is exactly the same for continuous and discontinuous variation. In fact, there does not seem to be any sharp dividing line between the two kinds of variability; the difference seems to be primarily due

to the number of genetic factors involved. We encounter discontinuous variation where only one or a few factors are involved, each producing a major effect, and we find continuous variation where many genetic factors, which produce small additive effects, unite in the shaping of a character'' (Mayr, '42, p. 72). In both cases mutation is active, in both cases the mutations are inherited, but in the case of discontinuous variation we are dealing with a major effect, in the case of continuous variation with a minor effect. Our study of the kind of diastematic variability encountered in the anthropoids helps us to understand that the non-diastematization of the dental series in man, and particularly of the premaxillary space, was such a major effect, and must have been produced by mutation. In the succeeding section we will discuss the question of the stage in the evolution of man at which this mutation may have occurred.

THE SIGNIFICANCE OF THE PREMAXILLARY DIASTEMA IN PITHECANTHROPUS FROM THE STANDPOINT OF THIS FORM'S RELATION TO MAN

Weidenreich ('37), arguing against Dubois's view that Pithecanthropus was a giant gibbon, states that ''Pithecanthropus is in no respect an ape, but a real hominid who is even in a more advanced stage of evolution than Sinanthropus.'' In the same paper Weidenreich states again that ''Sinanthropus has to be considered as representing a more primitive type than Pithecanthropus. Nevertheless, both belong to the same group of hominids when compared with other human forms,'' ('37, p. 64). In a more recent paper Weidenreich ('40) has expressed himself somewhat more cautiously as to the relative degree of primitiveness of Pithecanthropus and Sinanthropus. He writes, ''Pithecanthropus and Sinanthropus, therefore, have to be regarded as representatives of the most primitive hominid group known hitherto. They are, however, not at all identical, both showing certain properties specific for one type but missing in the other. Yet the differences are not greater than those found among different

races of present mankind settling in different regions of the earth. Which is more primitive is difficult to tell because of the peculiar combination of primitive and advanced features in each of the types.''

The fact that Pithecanthropus IV was characterized by a large premaxillary space (fig. 1) whereas Sinanthropus has no space at all, being distinguished by the characteristic absence of diastematization specific to man (but found also in the extinct Australopithecine apes and in some female adult orangs), would certainly separate these two forms into, at least, two distinct genera, and certainly renders Weidenreich's statement that ''the differences are not greater than those found among the different races of present mankind'' quite unacceptable. Absence of the premaxillary space in any group of apes would not necessarily admit it into the hominid group, but presence of the premaxillary space should certainly exclude it, for the space represents an important morphological difference. However this may be it would certainly not seem a sound procedure to regard two groups exhibiting this particular diversity of features as belonging to the same species. It would seem obvious that no anthropomorphous group exhibiting such a diastema could be directly ancestral to any form of Homo sapiens.

Weidenreich assumes ''that Pithecanthropus and Sinanthropus are direct ancestors of Neanderthal Man'' ('40, p. 380). I think this extremely unlikely for the reason, among others, that Neanderthal Man had no premaxillary diastema and is morphologically far too advanced a form to have had Pithecanthropus as a direct ancestor. It is highly improbable that the mutation to reduced premaxilla occurred first in Neanderthal Man. On the other hand it looks very much as if in Sinanthropus we may have the form in which the mutation from premaxillary to non-premaxillary diastema occurred. It may be that Pithecanthropus is directly ancestral to Sinanthropus. This view seems to me to be an interpretation more in harmony with the facts than Weidenreich's.

The absence of premaxillary diastemata in the Australopithecine apes suggests the possibility that loss of the diastemata in the primates may have occurred more than once, and probably did.

We cannot assume that non-diastematization of the teeth first appeared in Sinanthropus for the reason that this condition was already present in the Australopithecine apes. But until other evidence becomes available it would seem a likely assumption to make that this condition first appeared in either some prehominid group intermediate between Pithecanthropus and Sinanthropus or in the Sinanthropus group itself.

SUMMARY

1. The skulls of 256 anthropoid apes of all age groups were studied (a), in order to discover the kinds of diastemata that were to be found or not between their teeth, and (b), in order to discover whether the variability in this connection served to throw any light upon the possible manner and the stage at which the dental, and especially the premaxillary, diastemata became completely reduced in man.

2. It is shown that the premaxillary diastemata are rarely, if ever, wanting in the anthropoid apes, with the exception of the adult female orang in whom it is absent in 5.8% of cases.

3. It is shown that there were probably two steps involved in the reduction of the premaxillary space, (1) reduction of the canine tooth, by mutation, and (2) reduction of the premaxillary space following upon this only after a fairly considerable interval.

4. It is suggested that this second step occurred in some form intermediate between Pithecanthropus and Sinanthropus, or possibly in the Sinanthropus group itself.

5. Seventeen tables giving the complete data obtained are provided.

LITERATURE CITED

BATESON, W. 1894 Materials for the study of variation. London & New York, Macmillan & Co.

GREGORY, W. K., AND M. HELLMAN 1926 The dentition of Dryopithecus and the origin of man. Anthrop. Papers Am. Mus. Nat. Hist., vol. 28, pp. 1–123.

——— 1939 The dentition of the extinct South African man-ape Australopithecus (Plesianthropus) Transvaalensis Broom. A comparative and phylogenetic study. Ann. Transvaal Mus., vol. 19, pp. 339–373.

GREGORY, W. K., M. HELLMAN AND G. E. LEWIS 1938 Fossil anthropoids of the Yale-Cambridge Expedition of 1935. Carnegie Inst. Washington, Publ. no. 495, pp. 1–27.

KOENIGSWALD, G. H. R. VON 1942 The South African man-apes and Pithecanthropus. Carnegie Inst. Washington, Publ. no. 530, pp. 205–222.

MAYR, E. 1942 Systematics and the origin of species. New York, Columbia University Press.

MONTAGU, M. F. ASHLEY 1935 The premaxilla in the primates. Quart. Rev. Biol., vol. 10, pp. 32–59, 181–208.

——— 1936 The premaxilla in Man. J. Am. Dent. Assoc., vol. 23, pp. 2043–2057.

——— 1938 The concept of atavism. Science, vol. 87, pp. 462–463.

——— 1940 The significance of the variability of the lateral incisor teeth in man. Human Biol., vol. 12, pp. 322–358.

NEEDHAM, J. 1942 Biochemistry and morphogenesis. New York, Cambridge University Press and the Macmillan Company.

WADDINGTON, C. H. 1940 Organisers and genes. New York, Cambridge University Press and the Macmillan Company.

WEIDENREICH, F. 1937 The relation of Sinanthropus Pekinensis to Pithecanthropus, Javanthropus and Rhodesian Man. J. Roy. Anthrop. Inst., vol. 67, pp. 51–66.

——— 1940 Some problems dealing with ancient man. Am. Anthrop., vol. 42, pp. 375–383.

PHYSICAL ANTHROPOLOGY AS A TECHNIQUE

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"Physical Anthropology deals with the evolution of man and with races." That sentence, or some version of it, is likely to be heard in the first lecture of any introductory course to the study of man. Such a definition, however, does not convey a very close idea either of its limits or of its affiliations. As a body of knowledge, it is true, the connections of physical anthropology are not hard to see: it embraces some of the interests of paleontologists, zoologists, anatomists, physiologists, pre-historians and ethnologists. It is rather as a working science that physical anthropology has been having some difficulty in making its pretensions clear. This may have had something to do with its loss of title, especially in America, to the single term "anthropology" as its designation. In 1932 Pitt-Rivers suggested "that the primary classification of anthropological subjects, instead of the classification by classes and methods of workers, may have been as injurious to Anthropology as the polygenetic search for a fixed number of human races. Were it nor for this," he asked, "would not Eugenics, Genetics, Demography and the study of populations, and of Psychology, have their recognized places as branches of Anthropology?" That the problem of the application and direction of physical anthropology is, ten years later, giving concern to its students may be seen in various signs, such as the current interest in methods of measurement.

At the 1942 meeting of the American Association of Physical Anthropologists one of the members rose and inquired of his brothers in science: "Why do you measure skulls?" It was asked in the heat of discussion, and I have forgotten the

connection. But is is a fair question, and I shall borrow it for rhetorical purposes and try to answer it.

We measure skulls because it is our basic scientific procedure, and it enables us to write from fact rather than from intuition. We began originally to measure in order to learn about races, and it was in this pursuit that methods of measuring expanded. The methods were primarily a new way of describing racial types, in numerical form, and it is this purely descriptive use of measurements and averages which has been stressed by many anthropologists, notably Hrdlička. As measurements became refined, and supposedly standardized, statistical methods of handling them developed in due course — methods in which measurement is looked on less as a means of describing a single racial group than as a means of examining the relation between two racial groups. In recent years the combined interest in exactness of measurement and in the mathematical statement of results has probably had its most obvious expression in the work of the Galton Laboratory under the aegis of Karl Pearson, where students have been applying to racial problems such abstracted devices as the Coefficient of Racial Likeness. By the latter, the degree of differentiation between groups is stated in a mathematical term which takes no account of the actual morphological nature of the groups involved. Nor is this the furthest extension of such statistical procedures, for the Polish school was the leader in proposing methods by which an assumed racial mixture of several types may be mathematically analyzed into its supposed original elements.

These somewhat refined formulae are not in general favor in this country, possibly because of a feeling that in them statistics has outstripped measurement in preciseness, apart from any flaws perhaps existing in the formulae themselves. Nevertheless, statistical methods are now widely applied in more general ways, and by them physical anthropology has learned much, and has equipped itself to make certain useful statements about a given group of people. We know, for example, what to expect in the way of normal variation in a

certain characteristic, and are therefore less likely than we once were to hack a population up into arbitrarily assumed types. In the same way, we can tell roughly whether we are dealing with a heterogeneous group which should not be treated as a unit, or which might be suspected of having a hybrid nature. We also know more about the relative worth of different measurements, and the limits of their usefulness. But principally we are able to say whether any measurable difference found between two groups is a reliable one.

To go further, it has been demonstrated that the normal curve is a real phenomenon in human variability and that man's measurable features live up to the predictions of statistical theory. Using this as a departure, we can find out things about qualities and variables in man which have nothing to do with the ordinary understanding of morphology and its variability.

In sum, then, physical anthropology has evolved a system for differentiating natural groups of people in a controlled way, and therefore has one of the requisites of an experimental science. (As Washburn ('42) says, the smaller a difference is, the more important measurement becomes.) The system grew up partly through the study of racial questions, but it is by no means restricted to them. Its basis is the understanding of normal variation, and its mark is the use of statistical methods. That is what is special about it.

Now I am only trying to explain why we measure skulls, and I hasten to say that this statement about physical anthropology would be well received by only a portion of my colleagues. Many of them object to any elaborate statistics, and the terms "caliper anthropologist" and "probable error anthropologist" have been uttered in scorn, goading one of my confreres to reply with "cadaver anthropologist", sotto voce. There is room for all, however, and in fact I see no substitute for measurement and statistical analysis. Hrdlička ('27) in defining physical anthropology expressed an important point as follows: "Its fundamental distinctive character lies in the fact that it deals with human groups rather

than with individuals, and that all its work is of a comparative, rather than simply descriptive, nature.'' I think Dr. Hrdlička was right, and I feel that this belief leads inevitably to the use of statistics.

Such disagreements as those I mention are probably partly growing pains, and demonstrate a divergence of opinion as to just what the functions of physical anthropology should be. There is another sort of internal pressure in physical anthropology as a science which is somewhat different, though important. This is that it is torn between two philosophies, Genetics and Biometrics, which are always tending to go off in two directions. The genetic approach to human biology, of course, sees human development as the resultant of the inheritance of a mass of particularized Mendelian characters, of an all-or-nothing type fundamentally, and it deems futile the biometric attack of measuring gross effects in the mass and using statistics on them. The basic antagonism of the two has had historical expression in the running debate between Pearson and Bateson, after the latter had discovered Mendel. But one can demonstrate that physical anthropology can encompass the ideas of both schools by pointing to the work of various more recent students.

Actually, however, by its own natural development physical anthropology has aligned itself mainly with biometrics. There lie its own methods and the aspects of man which it studies, for it could hardly wait with folded hands for the intricate study of human genetics to catch up with its problems. Now of course the science of biometry is older, and for a long time had the field to itself, as it grew under the hands of Pearson and his followers, of whom this country's lamented star was Raymond Pearl. But it was Boas (not, so to speak, a lineal descendant of Pearson) who first saw the scientific possibilities of physical anthropology in these same terms. Forty years ago he was discussing methods of analysis; and subsequently he gave illustrations, in his studies of immigrants and of growth, of the ways in which physical anthropology could be used in the investigation of culture and of population,

and he made further suggestions along the same line which have not to this day been acted upon.

It is Hooton (again not a lineal descendant of Pearson or of Boas) who has mainly developed the sort of investigation which Boas had begun. His own outstanding study of this kind has been his recent attempt to differentiate the criminal physically, but he has also fostered the same ideas among those working under him, an example being Bowles' work on "New Types of Old Americans at Harvard," a demonstration of a secular change in average physique in a part, at least, of the population. Of Hooton's former students, Shapiro carried out still another investigation, with the same kind of social importance, in his work on the effects of selection and environment on Japanese immigrants to Hawaii; thus harking back to Boas' classic study. But the Hootonians are not the only ones who have put forth such efforts. Sullivan ('23), for example, made perhaps the most careful analysis existing of the relations of physique and intelligence, and Pearl consistently furthered the investigation of problems of body type and disease, and similar ones, by the use of biometrical methods, which is to say by the combination of anthropometry and statistical analysis.

It seems to me, therefore, that we have a sound and useful technique, but one which has not by any means been completely explored. I have said it is essentially a method of differentiation. I quote a rather tart but justifiable comment of Gregory's ('37), thrown in as he was describing the scene around a gorilla which Raven had just shot:

"One of the natives did something which surprised me considerably. He was evidently trying to convey to another man the idea that the gorilla was very big. He took a stick and held it against his own upper arm, holding his thumb and forefinger at the right distance from the top. Then he placed the stick in position along the front of the gorilla's upper arm to show the difference in favor of the gorilla. Here, I thought,

is the beginning of physical anthropology, and for that matter, here is where physical anthropology has too often stopped, with a mere measurement of differences.''

I suggest that progress will come in the recognition of wider uses of our general method. We have kept up our valuable companionship with ethnology, reconstructing history through the study of race. But at the same time students in other fields have begun to use our approach, or an approach kindred to it. It might be said, for example, that the Chicago study of identical twins was essentially a job of physical anthropology. Varying applications are not hard to find. Our own population and its dynamics should be a field of great fertility and importance. I believe that we have much to learn from students of population, and that they can learn much from us, a belief which they share.[1] The important questions in this case are those of variation and differentiation within a population. Now physical anthropology is based on the notion of variation and has a technique for studying differentiation, and it should be able to help clarify the quantities and processes involved in eugenics, as we understand eugenics today.

General anthropometric studies of an occidental population have been suggested from time to time in the past, but they have never been carried through, except in the case of Harvard's yet unpublished survey of Ireland. Within the last few years two British journals (Nature and the Eugenics Review) have had editorials calling for just such a survey of England. Actually there is no nation, least of all ours, which has a true idea of how its population is composed physically. We have an inkling as to forces which might affect its physical form, in the studies of Boas, Shapiro, Bowles and others, but we still have no point of beginning, for reference. If there are differences according to region and class, what are they, and what is their actual significance? Those are simple questions about which we know nothing whatever.

[1] See The problems of a changing population, Report of the Committee on Population Problems, National Resources Committee, 1938.

The distribution of head size, let us say, geographically and socially might or might not be a useful accumulation of data. We do not know. There are a few suggestions, however, that head size or body size may be indicators of constitutional vigor to some extent. Though it is not the same thing, the fact of increasing stature in recent generations has been interpreted in part as being due to better conditions of health. It would probably be utopian to ask medicine to devise some sort of index of general constitution, comparable for mass investigation with the IQ, whatever faults the latter may have; but anthropology would stand obliged to anyone who could produce such a thing.

In such fields as I have suggested there will, I think, be found the most promising practical relations between physical anthropology and sociology, or social anthropology. But I hope it will not be thought that I am trying to redefine physical anthropology, or to limit it in any way. I started out to say why we measure skulls, and I have therefore been dealing with it purely as a special scientific method. Nor do I mean to imply that as a store of knowledge physical anthropology is any less useful than as a technique. For example, I believe that only a fuller knowledge of fossil man will give us all the answers as to the nature and origin of races, a matter in which our doctrines have been based on guesswork. And I should like to cite Dr. Washburn's suggestion that the study of the primates furnishes the logical laboratory for experimental physical anthropology, because of the impossibility of really controlled experiments in the case of man.

LITERATURE CITED

GREGORY, W. K., AND H. C. RAVEN 1937 In quest of gorillas. Darwin Press, New Bedford, Mass.

HRDLIČKA, A. 1927 Anthropology and medicine. Am. J. Phys. Anthrop., vol. 10, pp. 1–9.

MURDOCH, KATHARINE, AND L. R. SULLIVAN 1923 A contribution to the study of mental and physical measurements in normal children. Am. Phys. Ed. Rev., vol. 28, pp. 209–215; 276–280; 328–330.

PITT-RIVERS, G. 1932 Anthropological approach to ethnogenics. A new perspective. Human Biol., vol. 4, pp. 239–251.

WASHBURN, S. L. 1942 Technique in primatology. Anthrop. Briefs., no. 1, pp. 6–12.

THE FISSURAL PATTERN IN THE BRAIN OF NEGROES AND WHITES (Continued)

THE OCCIPITAL LOBE

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TEN PLATES (FORTY-TWO FIGURES)

The sulci on the occipital lobe were for many years the object of study by brain anatomists and much discussion arose regarding homologies, resulting in a rather extensive literature. The discussion centered mainly around the question whether or not an "Affenspalte" or sulcus simialis or its homologue was ever present in the human brain.

Elliot Smith ('03 and '04) greatly clarified the problem by relating the sulcus to the associated cortical layers and introduced the term sulcus lunatus to designate the furrow which bounds anteriorly the visual or striate area on the lateral surface of the occipital lobe. He defined the s. lunatus as "a depression formed by the forward projection of the cortical area containing the stria of Gennari."

We have here a definite criterion for judging the presence of the lunate sulcus. And as thus defined the sulcus occurs in the human brain as it does in nearly all the Primates. It can also be said that it is homologous to the s. lunatus in other Primates just as the central sulcus is homologous to that in the various groups of Primates. The sulcus lunatus can generally be recognized by its topographical as well as its cortical relations.

The term s. lunatus, however, is often used as the equivalent of fissura simialis or "Affenspalte." Elliot Smith spoke of the s. lunatus in man as "representing" that fissure. Whether

the s. lunatus of the human brain is homologous to the "Affenspalte" is a question that has given rise to much discussion. The use of the latter term seems to create more confusion than clarity, as it does not always stand for equivalent morphological features. The term is to some extent a quantitative one and therefore does not apply equally to all conditions as found in Primates. The conditions vary even within the group of anthropoid apes, and when we examine the occipital lobe in a series of human brains we find that there is a still larger range of variation. In some specimens we see a simple pattern somewhat similar to that of certain infra-human brains. But we should hardly expect to find in the occipital lobe of the human brain precisely the same morphological features as in any of the infra-human groups, though the similarity in some cases is very striking. The variations are largely a matter of the degree of opercularization by the posterior lip of the s. lunatus or of the extension of the sulcus on the lateral surface, and these features can be precisely expressed or illustrated for the various groups.

The s. lunatus approximately limits anteriorly the striate area on the lateral surface of the occipital lobe. The area striata in the human brain, as shown by various investigators, does not quite reach the posterior lip of the s. lunatus as it does in lower forms where the sulcus more precisely limits the area. The sulcus lies rather in the peristriate area and exemplifies a phenomenon noted by Ariëns Kappers ('36), namely, the inertia of sulci in accomodating themselves to changes in the cytoarchitectonic fields. We shall see later that other sulci, namely the polar sulci, limit the striate area on the convex surface, but these are not interpreted here as parts of the true lunate sulcus.

The posterior lip of the s. lunatus is opercular and overlaps in varying degrees the transitional gyri or "plis de passage" of Gratiolet connecting the occipital and parietal lobes. It may be useful to recall the conditions present in the various groups of Primates which were previously illustrated.

In the lower Primates, such as the platyrrhine Ateles, the first transitional gyrus or "pli de passage" of Gratiolet, which curves around the lateral end of the parieto-occipital fissure and the dorsal end of the lunate sulcus, is on the surface. Likewise the second transitional gyrus between the transverse occipital and the lunate is generally exposed, while the third gyrus is ventral to the lunate fissure.

The opercularization of the transitional gyri in other groups is due to the great increase in the cortex of the occipital lobe. The posterior lip of the s. lunatus becomes opercular and extends over the caudal wall of the parietal lobe. This process reaches its maximum in some of the Cecopithecidae, e. g., in the macaque where all transitional gyri are operculated. Springing forward from the convexity of the lunate, a sagittal sulcus, the prelunate is often present.

In this high degree of opercularization, the lateral end of the parieto-occipital fissure and the caudal end of the intraparietal sulcus superficially form one continous furrow with the opercular lip of the s. lunatus. The caudal end of the intraparietal, namely the transverse occipital, lies buried under the posterior lip of the s. lunatus or it may become one with the s. lunatus on the floor of the cleft.

Typically the s. lunatus is of crescentic form with its convexity directed anteriorly and extending from the medial to near the ventral border of the hemisphere. Within the area bounded in front by the lunate, lies usually a Y-shaped sulcus, the external or lateral calcarine with its branches directed medially and embracing the caudal end of the retrocalcarine, or its lower branch.

A secondary emergence of the first transitional gyrus may occur in some members of the Cercopithecidae such as Presbytis (Semnopithecus) and this is the usual condition in the anthropoid apes where part of the second transitional gyrus may also be exposed on the surface.

In the anthropoid apes the Y-shaped lateral calcarine exhibits considerable variety of form and even the two lobes of

the same brain may differ markedly. The branches often spread in a vertical direction or the sulcus separates into the two elements (x and u of Kükenthal and Ziehen) which were originally distinct and had become secondarily united.

The stem of the Y-shaped sulcus and its prolongation, the lower branch, extends medially and downward toward the occipital pole below the caudal extremity of the retrocalcarine. This relation of the retrocalcarine with its caudal extremity lying between the two branches of the Y-shaped lateral calcarine is of remarkable constancy throughout the Primate series. The two sulci are both parts of the intrastriate system.

Below the ventral end of the s. lunatus but largely on the basal surface is the inferior occipital sulcus which is the lower limiting sulcus of the striate area. This sulcus in the anthropoids has undergone a great change in form and position from its condition in the lower Primates. Though now largely on the basal surface, its caudal part comes on the lateral surface of the occipital lobe. The position of the primitive inferior occipital sulcus is often occupied by a small furrow which Ingalls ('14) called the sublunate. The inferior occipital sulcus of the human brain cannot therefore be homologous to that in the lower Primates as it has already become greatly modified in the anthropoids. Occasionally, however, the sulcus in the human brain has a form similar in appearance to the primitive form.

In man there occurs a great expansion of the parietal lobe, especially in its caudal region (areas 18 and 19 of Brodmann) and the transitional gyri fully emerge, pushing back the striate cortex toward the occipital pole and exposing the caudal end of the intraparietal or transverse occipital sulcus. The lunate sulcus follows the striate cortex back toward the pole and thus loses its moorings with the transverse occipital, which becomes exposed on the surface. The transverse occipital sulcus is therefore not equivalent to the s. lunatus and does not represent it.

In this backward growth, however, the s. lunatus may be broken up so that it may with difficulty be recognized even in

its elements. It is of course not implied in this description that a single brain passes through this growth process. We know on the contrary that its final pattern is already basically determined before birth. But, as we shall see, our specimens illustrate all these stages of development.

Elliot Smith ('04) found the s. lunatus to be quite common in the Egyptian Fellah brain and in the Sudanese and to be of a primitive form. The sulcus was found in such a high percentage of cases that he regarded it as a normal feature of the human brain. It is generally stated to have been present in the brain of early man, judging by their endocranial casts, and to be especially common in primitive races. Shellshear ('37) found it to be quite common in Australians and frequently of a very primitive type.

Murphy ('10) observed a distinct s. lunatus in eleven hemispheres of ten Negro brains, and Poynter and Keegan ('15) in a study of thirteen Negro brains obtained results similar to those of Elliot Smith, but they do not state the frequency of the lunate sulcus.

The s. lunatus has been reported by several investigators for the various groups of Whites, and in fact the sulcus has been observed in all human races so far examined, so that it is not a racial character. The sulcus has also been reported for the brains of scholars and statesmen, and is accordingly not an inferiority character.

Recently Levin ('36) studied a large series of White adult and fetal brains. In the adult series, of seventy-seven hemispheres of the brains of distinguished people he found a more or less marked lunate sulcus in 71%, practically the same frequency as he found in 100 hemispheres of ordinary people, namely 72%. (Cf. Levin for the literature on the frequency of the lunate sulcus in different races.)

The percentage of cases in which the sulcus is said to be present varies considerably in different races. But it is important to note that the percentages given for the same race differ widely according to the investigator. Obviously the criterion for judging the presence of a sulcus lunatus differs

among the authors, some recording perhaps only the primitive type. The form and position of the s. lunatus differ so markedly in different specimens that unless these are accurately described or illustrated, the percentages recorded do not give the desired information.

If we compare the occipital lobe of a highly developed human brain with that of an anthropoid, a striking difference between the two is apparent. In the human brain the fissuration of the occipital lobe is often quite complex and at first sight it seems hardly possible to recognize any elements common to the two brains. In the anthropoid ape the s. lunatus extends from the dorsal to near the ventral border as a deep arcuate cleft into which dips the caudal end of the intraparietal or transverse occipital sulcus. The opercularization is extensive, involving as a rule even part of the first transitional gyrus. A prelunate sulcus when present is small.

But the s. lunatus in the human brain may assume a form much resembling that extisting in the infra-human Primates. That is, a crescentic furrow may be present on the lateral surface with its posterior lip opercular and with the typical relation to associated sulci that show their equivalence in an unmistakable manner. The degree of opercularization in the human brain probably never attains that shown usually in the infra-human Primates, but there can hardly be any question as to the identity of the sulci concerned. We may correctly speak of these sulci as being homologous, even though, as Retzius (1896), Zuckerkandl ('04) and Sergi ('08) held, a complete "Affenspalte" is never found in the human brain.

The lateral surface. In the description of the occipital lobes, the simpler conditions will be considered first and then the more complex conditions. This does not imply that other parts of the brain are correspondingly at the same level of development; a prominent lunate sulcus may be present in a well-developed brain. But it may be stated here that in our material the most primitive type of lunate sulcus, that is, one that is of large crescentic form, well advanced on the lateral surface and possessing a well-developed opercular lip, is more frequently

found on brains that are as a whole very simple in their fissuration. On the other hand, the lunate sulcus may be present in a highly developed brain but its form and position may be quite atypical. It is important to take this fact into consideration in reading the percentages given by authors for the presence of the lunate sulcus.

Figures 1 and 2 illustrate the occipital lobes of a very simply fissurated Negro brain (weight, 921 gm.). On the left lobe (fig. 1), the short paroccipital sulcus (par) terminates in the transverse occipital (otr), the outer branch of which almost reaches the deeply opercular lunate sulcus (L). The parieto-occipital fissure (po) comes on the lateral surface for a considerable distance. It is axial to the first transitional gyrus (I) or arcus parieto-occipitalis. The second transitional gyrus (II) runs between the transverse occipital and the lunate sulcus, and the third (III), below the lunate.

From about the middle of the arcuate lunate sulcus, a prelunate sulcus (pl) proceeds anteriorly. Below the lunate sulcus is the occipital inferior (oci) passing to the basal surface. This sulcus, as previously mentioned, undergoes much change in the anthropoids. It is here quite simple, but cannot be said to be homologous to that in the lower forms.

Within the space bounded by the lunate are the two branches of the lateral calcarine (lc), the stem and the lower branch being almost joined by the upper (u) branch and surrounding the caudal end of the retrocalcarine.

On the right hemisphere (fig. 2) the lunate is still larger, extending 3.5 cm. from the medial border, and having two small prelunate sulci. Here a more primitive condition exists, in that the transverse occipital sulcus (otr) dips beneath the opercular lip of the lunate, so that part of the second transitional gyrus is submerged. The lateral calcarine bifurcates at the medial border, its branches again surrounding the caudal end of the retrocalcarine. The inferior occipital (oci) of primitive form extends along the lower border and then ascends on the convex surface.

In the next specimen (fig. 3) the terminal portion of the transverse occipital runs laterally under cover of the lunate operculum. The upper (u) branch of the lateral calcarine forks; the lower (lc) is superficially concurrent with the retrocalcarine, but is separated by a submerged gyrus and occupies its normal position, that is, below the caudal end of the retrocalcarine. The combined sulci form a prominent fissure running horizontally across the occipital lobe.

On the right hemisphere of the same brain (fig. 4) the transverse occipital (otr) again joins the lunate and a prelunate (pl) superficially meets the anterior occipital (a^3). The upper branch of the lateral calcarine parallels the main sulcus (lc) in its lateral extent. A paramedial sulcus (pm) is seen near the dorsal medial border.

In the next Negro specimen, left hemisphere (fig. 5) the transverse occipital just reaches the lip of a small but crescentic lunate sulcus. The lateral calcarine (lc) has two small branches enclosing the caudal end of the retrocalcarine. There is present a vertical accessory lateral calcarine (ac) lateral to the main sulcus.

The right occipital lobe (fig. 6) is even more diagrammatic in pattern than the left. Here the transverse occipital (otr) dips under the lunate operculum and a simple Y-shaped lateral calcarine directs its branches medially enclosing the termination of the retrocalcarine. A typical paramedial sulcus (pm) extends along the dorsal border of the lobe.

Figure 7 shows a simple crescentic lunate sulcus on the left hemisphere of a White brain. The pattern of the sulci is simple and requires no comment. It is one of the simplest in the White series.

On the right hemisphere (fig. 8) of the same brain, the lunate has not the typical crescentic form though it is superficially joined by the transverse occipital. The paramedial likewise superficially meets the medial end of the lunate sulcus.

Figure 9 shows a more irregular lunate sulcus with small curved branches, which are characteristic of the sulci in other parts of this White brain. Its opercular feature and topo-

graphical relations reveal its true nature. On the right hemisphere (fig. 10), the transverse occipital has separated from the caudal end of the paroccipital (par), as frequently happens. The paramedial lies for its greater part on the medial surface. The lunate though small is typical in form and position.

Figure 11, also of a White brain, shows a more vertically placed lunate sulcus. This form occurs more frequently among Whites, at least as represented by these German brains. This is probably correlated with the shape of the brain, which is shorter and higher in Whites than in Negroes. But especially growth pressure exerted in the parietal lobe would have just such an effect, namely of tending to straighten out the simpler arcuate lunate sulcus. The upper and longer branch of the lateral calcarine is directed upward toward the shallow concavity of the paramedial. This probably reflects a tendency to a vertical thrust of the striate area near the medial border, a process which will be illustrated in succeding specimens. Moreover the paramedial sulcus appears to become morphologically a dorsal limiting sulcus of the striate area, as Shellshear ('37) noted in his study of Australian brains.

The right hemisphere of this brain (fig. 12) shows a simple fissuration. However, only the depth and opercular nature of the horizontal sulcus marked L indicate that it is a reduced lunate, though this is uncertain. No microscopic examination was made to ascertain the extent of the area striata as these specimens are kept intact as far as possible.

Figure 13 is a photograph of the occipital aspect of a Negro brain illustrating the typical conditions present in the specimens so far discussed, and figure 14 gives an interpretative drawing of the same brain. On the left hemisphere is a primitive crescentic lunate sulcus (L), which is joined deeply by a transverse occipital sulcus, but separated by a submerged gyrus. A short prelunate (pl) is present. The intraparietal (ip) is concurrent superficially with the parieto-occipital fissure (po). The paroccipital (par) is quite short.

Within the area limited anteriorly by the arcuate lunate sulcus, is a deep horizontal sulcus, the retrocalcarine (rc).

It ends unbranched on the medial surface, and is separated by a small gyrus from the main part of the fissure. Two lateral calcarine elements (lc) surround the lateral termination of the retrocalcarine. The paramedial (pm) superficially meets the parieto-occipital fissure and exhibits a typical form. Anterior to the lunate is the anterior occipital (a^3).

On the right hemisphere, the lunate is less typical in form. The transverse occipital, however, is in contact with it and also with the lower end of the paramedial (pm).

The stem of the lateral calcarine lies horizontally, its branches enclosing the lower branch of the retrocalcarine (rc). This relation of the two intrastriate sulci is very typical throughout the Primates when the branches of the lateral calcarine are present and directed medially. Near its lateral extremity are accessory calcarine elements (ac).

Figure 15 shows a large lunate sulcus, but less primitive in form. On the right hemisphere (fig. 16), the lunate is situated nearer the occipital pole. The prelunate (pl) superficially meets the anterior occipital (a^3).

In figure 17 the lunate is seen to be broken into two parts by a slightly submerged gyrus. On the right hemisphere (fig. 18) the pattern is more complicated. This occipital lobe, though of a small brain, is well fissurated. The upper part of the lunate has separated and superficially joined the paramedial. With the prelunate it forms the superior lateral sulcus. The branches of the lateral calcarine have spread apart, the upper being prolonged vertically toward an opercular sulcus on the medial border, the opercular sulcus (s) of Bolton. This indicates a dorsal extension of the striate area, more typical examples of which will be shown later.

Figures 19 and 20 show respectively the left and right occipital lobes of a Zulu brain. The right lobe shows a simpler pattern than the left. Here the lunate is separated into two parts by a submerged gyrus. The retrocalcarine comes on the lateral surface for a considerable distance. On the left hemisphere, the lunate has separated into a dorsal (Ld) and a ventral (Lv) part. The prelunate with perhaps a part of the lunate

forms a distinct horizontal fissure, the occipitalis lateralis of human anatomy. That this interpretation is correct will appear from the conditions present in the specimens to be considered later. Frequently two such prelunate sulci are present.

In the specimens hitherto discussed, the folding of the striate cortex is horizontal if we judge by the position of the sulci known to be associated with that area. In some of the specimens of our series, branches of the Y-shaped lateral calcarine spread out so that a T-shaped sulcus is formed. An approximation to this form is present in the specimen shown in figure 18, though the greater part of the lower branch is not visible in the drawing.

The T-shaped lateral calcarine is often opposed by a similar T-shaped caudal extremity of the retrocalcarine. We may perhaps interpret this as a balanced condition between the growth energies exerted from the lateral and medial surfaces. The caudal branches of the retrocalcarine may be separated from the rest of the retrocalcarine by the emergence of the posterior cuneo-lingual gyrus forming a vertical sulcus near the medial border, which Elliot Smith ('04) has termed the calcarinus verticalis.

But a similar vertical calcarine may be produced by the separation of the spread branches of the lateral calcarine and indeed the sulcus may come to lie on the medial surface. This origin of the vertical calcarine may be identified by the short vestigial stem directed laterally. When the stem of the originally Y-shaped sulcus is thus greatly shortened, or is close to the medial border, compensatory accessory elements of the lateral calcarine appear on the convex surface of the lobe. Occasionally a straight horizontal sulcus appears on the medial border between the extremities of the retrocalcarine and the lateral calcarine.

In the following specimens we shall see examples of a dorsal extension of the striate area combined with a very obvious lateral extension of this area, as indicated by the very typical crescentic lunate sulci.

Figure 21 shows the left occipital lobe of a White brain. The lunate is vertical in position and possesses a long prelunate. The stem of the lateral calcarine has separated from the rest of the sulcus consisting of the branches and a small spur showing the point of attachment to the main part of the stem. The branches spread on the medial border to form a vertical calcarine. The relations of the sulci are more clearly seen in an occipital view of this lobe (fig. 23).

On the right occipital lobe (fig. 22) there is a well-developed arcuate lunate sulcus. It terminates dorsally just anterior to the lateral branch of the transverse occipital and lies partly submerged in that sulcus. This unusual relation of the lunate termination to the transverse occipital occurs in several specimens of our series and has been observed by other investigators. Medial to the lunate sulcus may be seen accessory elements (ac) of the lateral calcarine. The stem of the originally Y-shaped lateral calcarine (lc) has separated from the branches. These are spread out but still maintain their position relative to the caudal end of the retrocalcarine (rc).

The upper branch (u) is directed vertically upward to the concavity of a sickle-shaped sulcus (s). This sulcus is markedly opercular, forming a projecting flap. From its opercular nature and its relations to the upper branch of the lateral calcarine it is interpreted as the polaris superior of Bolton. The sulcus is, however, more laterally placed than the typical polaris superior and illustrates a condition similar to one described by Elliot Smith ('29), who was at first inclined to regard the sulcus as the dorsal part of the lunate. From its relation to the upper branch of the lateral calcarine, we may infer that this sulcus polaris superior is approximately a limiting furrow of the striate area, and thus indicates a dorsal extension of this area.

Topographically the polaris superior appears to be derived from the paramedial, though there is evidence that it also arises independently. This paramedial origin is apparent from a posterior view (fig. 23) of the two lobes represented in figures 21 and 22. Conveniently the sulci on the left orcipital lobe show

an interesting transition stage to that on the right. The paramedial sulcus (pm) on the left side cuts across the medial border. A separated section of the sulcus is located more laterally. From its opercular feature as well as its position, it answers to the definition of a sulcus polaris superior. Further, the upper branch of the lateral calcarine which forms with the lower a vertical calcarine is directed to the concavity of the opercular sulcus. On the right side there is simply a lateral displacement of the sulci and presumably of the striate area. The superior polor sulcus (s) is seen to be a modified paramedial sulcus with an opercular lip more developed in comparison to that of the left side.

When the s. polaris is more medially placed, the upper branch of the bifurcated caudal end of the retrocalcarine passes to the concavity of the polaris superior and the lower branch to the polaris inferior on the basal surface. This is strictly speaking a feature of the sulcus as defined by Bolton. In some of our specimens, however, both the upper branch of the retrocalcarine and the upper branch of the lateral calcarine pass to the concavity of the polaris superior. When the striate area is placed more laterally, the upper branch of the lateral calcarine only is directed to the polaris superior as in both hemispheres of this brain.

Antoni ('14) rightly distinguishes the superior and inferior opercula on the one hand and the lateral operculum on the other. The lateral operculum is formed by the posterior lip of the true lunate sulcus and is equivalent to that in infrahuman forms. It reveals approximately the lateral extension of the striate area, while the polar sulci are the result of a dorso-ventral extension of the striate area.

The specimen illustriated in figures 23, shows, however, that the two types of opercula may be well developed in the same brain. There can be no question of the identity of the lunate on the right occipital lobe which shows the crescentic primitive form and is superficially concurrent with the transverse occipital sulcus. The lunate proper further shows the typical relation to the stem (here separated from the rest of the

sulcus) of the Y-shaped lateral calcarine. The lunate sulcus on the left hemisphere, though less typical in form is likewise a true lunate sulcus.

Both the polar sulci and the lateral true lunate approximately limit anteriorly the striate area, and are hence morphologically similar, but their origin is different. The polar sulci do not represent separated parts of the primitive crescentic lunate seen on the lateral surface of the brain of anthropoids, but are due to a dorso-ventral extension of the striate area. The inferior polar sulcus, when present is on the basal surface near the occipital pole. Both superior and inferior polar sulci are more comparable to the dorsal and ventral limiting sulci of the striate area on the medial surface and with these they are often continous.

The lunate sulcus limiting the lateral extension of the striate area of the human brain is homologous to the s. lunatus in other Primates, but the posterior opercular lip in the human brain probably never reaches the degree of development attained in the so-called ''Affenspalte'' of the lower forms.

Although the superior polar sulcus is a sulcus distinct from the true lunate situated laterally, it may become concurrent with it, so that a great curved sulcus extending to the medial border is formed. This is well seen in figure 24 illustrating the occipital aspect of another White brain. A comparison with the previous figure is illuminating.

In both hemispheres the lunate has the irregular form with small branches so common in our series of Whites. On the left hemisphere the lunate is superfically joined by the transverse occipital sulcus. Crossing the medial border is the paramedial sulcus. It is quite opercular and toward its concavity the upper of the outspread branches of the lateral calcarine is directed. The more laterally placed furrow is evidently the stem of the originally Y-shaped sulcus. The caudal end of the retrocalcarine (rc) comes on the convex surface without bifurcating. Below the vertical part of the lateral calcarine and largely on the basal surface, is an inferior polar sulcus (i).

On the right hemisphere the lateral branch of the transverse occipital (otr) dips under the anterior lip of the lunate. The paramedial is seen passing from the medial border and turning dorsally as the superior polar sulcus (s) is then continuous with the lunate. Morphologically then there is a stage represented here, where it would be difficult to decide, except for the presence of a small submerged gyrus, where the lunate ends and the superior polar sulcus begins. But we are hardly justified on that account, in homologizing the entire combined sulcus with the lunate located more laterally.

The retrocalcarine comes on the lateral surface for a considerable distance, and its upper and larger branch as well as the lateral calcarine is directed toward the s. polaris superior part of the arched furrow.

It may be well at this point to discuss more fully the relations of the lateral (external) calcarine to the caudal end of the retrocalcarine, as these two furrows are often not distinguished from one another in the literature.

I think it is clear from the illustrations of the simpler specimens of our series that the Y-shaped lateral calcarine on the convex surface is an intrastriate sulcus comparable to that of other Primates. It may not be strictly speaking homologous to that in the lower Primates, for in the anthropoids the sulcus may already be broken up, and yet it reappears in the human brain in its simple form, probably as the result of similar mechanical factors.

The lateral calcarine is gradually pushed to the medial border, presumably with the striate area, and as a rule the branches spread so that a rectangular bifurcation on the medial border or on the medial surface results. This is often faced as we have already seen by a similar rectangular bifurcation of the retrocalcarine. The branches of the latter may separate by the emergence of the gyrus cuneo-lingualis posterior to form the calcarinus verticalis of Elliot Smith. If part of the trunk of the retrocalcarine is separated with the branches, a triradiate sulcus on the medial border is formed. This sulcus is often termed the external calcarine. An examination of the

medial surface of our specimens show many stages in the separation of this sulcus, such as are illustrated by Antoni ('14). It may be called the pars posterior of the interrupted retrocalcarine. It is marked rc in all our illustrations whether the caudal portion is separated or not from the rest of the furrow.

However named, it is not to be confused with the Y-shaped lateral calcarine marked lc in all the drawings. Ample proof of this is furnished by the presence of both sulci on the same hemisphere. In figure 23, left hemisphere, the lateral spur on the vertical sulcus (lc) indicates its relation to the horizontal stem. On the right side the lateral calcarine is easily identified. The caudal branches of the retrocalcarine appear on the lateral surface, the lower however, in great part hidden. Similar conditions are present on the hemispheres shown in figure 24. On the right hemisphere the retrocalcarine runs farther on the convex surface than on the left with the consequence that the branches of the lateral calcarine are separated.

The lateral calcarine may split off its vertically running branches to form a calcarinus verticalis similar to that derived from the retrocalcarine. A small lateral stem usually indicates its origin. An approach to this condition is seen on the left hemisphere in figure 23 where the vertical sulcus is on the medial border and could be called a vertical calcarine. With the pushing of the striate area farther onto the medial surface, the lateral calcarine often breaks up and only accessory elements may remain. Even these may disappear, while the separated caudal portion of the retrocalcarine may be quite distinct.

The identification of these two sulci is of importance in interpreting the presence of a true lunate as distinguished from the polar sulci. The stem of the Y-shaped lateral calcarine is directed toward the concavity of the true lunate sulcus. The medially directed branches may spread vertically indicating a dorso-ventral extension of the striate area and they may be capped by the superior and inferior polar sulci. Likewise, the terminal branches of the retrocalcarine may be

directed to the polar sulci. According to this identification of the sulci, the dorsal one of the two sulci which Levin ('36) interprets as lunate sulci, is the superior polar sulcus and not a part of the true lunate. The distinction is important if reliance is to be placed on the frequencies of the lunate sulcus reported for the various races.

The application by Elliot Smith of the term external calcarine to the sulcus separated off from the posterior end of the retrocalcarine led some to regard this sulcus as identical with that on the lateral surface which occurs in nearly all Primates. The sulcus may represent the vertical branches of the retrocalcarine (vertical calcarine) or it may involve part of the main trunk similar to, but not identical with that on the lateral surface, namely the lateral calcarine (also, superior occipital, s. diagonalis, s. triradiatus, s. intrastriatus).

There is obviously a reciprocal relation extisting between the retrocalcarine and the lateral calcarine. The former may come on the lateral surface and disrupt the latter. More frequently the lateral calcarine moves toward the medial border with the striate area, and its outspread branches may form the vertical calcarine near the medial border, in which case the retrocalcarine remains on the medial surface of the lobe. The vertical branches of both sulci may be directed toward the polar sulci, or of either one alone according as the striate area is more medially or laterally placed.

Figure 25 is a photograph of a White brain of less than average weight (1195 gm.), and in figure 26 an interpretation of the sulcal pattern of this brain is given. The specimen again reveals a combined type of opercula, both the lateral lunate and the superior polar sulci being present on both hemispheres.

On the left hemisphere a typical crescentic lunate is present with a prelunate extending to the anterior occipital. The lateral branch of the transverse occipital is separated from the lunate by a narrow and partly submerged gyrus. On the right hemisphere the transverse occipital dips under the lunate operculum. On both hemispheres the uninterrupted retrocalrarine comes on the lateral surface and its dorsal and longer

branch is directed to the concavity of a superior polar sulcus. This sulcus is here formed independently of the paramedial. The lateral calcarine is represented by an oblique furrow. The inferior occipital (oci) on the left side is disrupted and a sublunate (b) surrounds the ventral end of the lunate sulcus, while on the right hemisphere the inferior occipital is continuous and joins the anterior occipital. An inferior polar sulcus (i) comes partly on the lateral surface.

v. Economo ('30) recognized two types of opercula in man. In one type, the pithecoid, the extension of the operculum is lateral, and is relatively of rare occurence in man. The other type, more frequently occurring in man and hence called the antropine, shows a dorso-ventral extension of the operculum. The dorsal extension produces, as Bolton ('00) previously showed, the superior polar sulcus, as illustrated in figure 26.

We have already seen that the lunate sulcus may be separated into two parts, a dorsal and a ventral. The gyrus separating these two parts was termed by Elliot Smith ('04) the gyrus translunatus. That the striate area extends to the dorsal and ventral parts of the lunate was confirmed by Shellshear ('37) in two Australian brains.

Figure 27 shows the dorsal and ventral (Ld and Lv) parts separated by the translunate gyrus, each part bearing a prelunate. The lunate parts tend to become horizontal and each with its prelunate to form a sulcus occipitalis lateralis, the lateral occipital superior and medius (Kuhlenbeck, '28). In such cases, according to the cytoarchitectonic studies of v. Economo ('30), there is no close association of these horizontal parts of the lunate with the striate area. On the right hemisphere (fig. 28) the lunate is small and a long prelunate extends from its convexity to meet a section of the anterior occipital. The transverse furrow dorsal to the lunate is probably a detached part of the transverse occipital but this is uncertain. There is a possibility that it may be a dorsal section of the lunate.

Figure 29 shows the left lobe of a brain in which the lunate is again divided into a dorsal and ventral section. The seg-

ments of the lateral calcarine occupy their typical positions surrounding the caudal end of the retrocalcarine. On the right hemisphere (fig. 30), the pattern is less schematic. A deep curved sulcus marked L is probably a reduced lunate but this is uncertain.

Figure 31 shows the left occipital lobe of a very large Negro brain weighing 1450 gm. The sulcal pattern is fairly schematic, however, the only feature to remark being the large curved sulcus surrounding the end of the transverse occipital and regarded as a compensatory sulcus (c). A somewhat similar sulcus is present on the right hemisphere (fig. 32). The two parts of the lunate are placed lower on this side as more frequently occurs. A highly developed vertical calcarine is present on the medial border of this hemisphere. It has a short horizontal stem (cv) which appears on the lateral surface in the drawing just opposite the ventral lunate. The vertical upper branch of the lateral calcarine is much longer than the lower and is directed toward a deep curved opercular sulcus, which is continuous with the paramedial (pm) on the lateral surface. It is a superior polar sulcus.

Figure 33 is that of a White brain showing the lunate again divided into a dorsal and ventral part, each provided with a prelunate. A lateral calcarine can no longer be recognized even as fragments and there is no interruption of the retrocalcarine which comes on the lateral surface. The small curved furrows may be regarded as accessory calcarine elements. On the right hemisphere (fig. 34) the lunate is irregular in form and superficially appears to run to the medial border. The medial part, however, is separated by a submerged gyrus and continues downward on the medial surface of the brain. Into its concavity is directed the upper branch of the bifurcated end of the retrocalcarine. It is a superior opercular sulcus (s).

Figure 35 shows two horizontal lunate parts with their respective prelunate sulci, the lower one superficially uniting with the vertical anterior occipital (a^3). The retrocalcarine has a T-shaped ending on the medial surface. A simpler condition is seen on the right hemisphere (fig. 36), where a small

continuous lunate is present. The paramedial (pm) occupies its typical position along the dorsal medial border. A vertical calcarine on this hemisphere is confined to the medial surface.

Figure 37 shows the left occipital lobe of a larger than average White brain (weight 1497 gm.). The lunate is continuous but placed obliquely. The branched caudal end of the retrocalcarine comes on the lateral surface. On the right hemisphere (fig. 38) a dorsal and a ventral part of the lunate are present, both lying horizontally. The short stem of the lateral calcarine (lc) passes to the medial border where its branches, dorsal and ventral, form the vertical calcarine, the terminations of which curve back to the lateral surface (cv).

Although the several specimens discussed above show a degree of lateral extension of the striate area as represented by the position of the lunate, this is accompanied in some specimens by a dorso-ventral displacement of the striate area as indicated by the development of the vertical calcarine.

The specimens that have been illustrated are typical of our series. A few other specimens could be selected in which the pattern is difficult to interpret. But in the great majority of specimens a lunate or its parts can be indentified from the topographical relations, for these are remarkably constant. The transition in this series from a simple crescentic lunate sulcus extending for a considerable distance on the lateral surface, through the specimens where the lunate is divided, to the complex type where only vestiges of the sulcus remain near the medial border, is so gradual that identification is possible in most cases. It is difficult therefore to divide the series into groups, for frequently some specimens of a group will present features which are characteristic of another group.

However, in view of the fact that the form of the lunate sulcus as exhibited in our series appeared significant, as well as the mere presence of a continuous lunate, I have divided the series into groups in order to give the reader some idea of the frequency of the types that have been illustrated. The series of 120 hemispheres (60 Negro and 60 White) have been divided into five groups as follows:

Group 1 Lunate sulcus crescentic in form with its opercular lip covering at least part of the transverse occipital sulcus.

Group 2 Lunate sulcus crescentic in form and wholly separated from the transverse occipital.

Group 3 Lunate sulcus irregular in form but continuous.

Group 4 Lunate divided into dorsal and ventral parts by the translunate gyrus.

Group 5 Lunate sulcus represented by fragments, or not identifiable.

Shellshear ('37) in his classification based on Australian material includes an "accessory" group in which an accessory lateral calcarine (externus) concentric with the lunate surrounds the outer end of the lateral calcarine. In our material the accessory calcarine may appear in any of the other groups. It appears to be of secondary importance and to correspond to Retzius' semilunar sulcus and produced by purely mechanical causes.

Table 1 gives the frequencies and percentages for the various groups in left (30) and right (30) hemispheres of Negroes and Whites.

TABLE 1

Frequencies of different forms of the lunate sulcus.

GROUP	1		2		3		4		5	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Negro (60)	5	5	6	7	6	5	7	9	6	4
percent	16.7	16.7	20.0	23.3	20.0	16.7	23.3	30.0	20.0	13.3
White (60)	2	–	2	5	14	13	7	7	5	5
percent	6.7	–	6.7	16.7	46.7	43.3	23.3	23.3	16.7	16.7

From the above table it is seen that a larger percentage of Negro hemispheres is present in group 1 than of White, indicating a greater degree of opercularization. The same is true for group 2. In this group the crescentic form of the lunate is more frequent on the left hemisphere than on the right in Whites.

Combining groups 1 and 2 it is seen that the crescentic form of the lunate is present in 36.7% of right hemispheres and 40.0% of left hemispheres in Negro brains, while it is present in 13.4% of right hemispheres and 16.7% of left hemispheres in Whites.

In group 3, the irregular, non-crescentic form of the lunate is present more than twice as frequently in Whites as in Negroes, with no appreciable difference in frequency between left and right hemispheres. The form of the lunate sulcus is quite characteristic of these White (German) brains, and may be correlated with the shape of the brain. In the shorter and higher White brain, the vertical or transverse course of the sulci is more frequent than in the longer and flatter Negro brain.

If we combine groups 1, 2 and 3, in all of which a continuous lunate sulcus is present, regardless of form, the frequencies are about the same in the two races, namely 56.7% of Negro hemispheres and 60.0% in White hemispheres. The frequencies are also about the same in groups 4 and 5.

The typically arcuate, least modified form of the lunate as shown in groups 1 and 2 are more frequently met in the Negro brain than in our White series. In group 4 where the s. lunatus is divided into two parts, there is no appreciable difference in the two races.

Elliot Smith ('04) observed that the lunate sulcus is more marked on the left hemisphere than on the right. This was also the conclusion of Antoni ('14) and Murphy ('15), while Levin ('36) found the frequencies to be about the same for both hemispheres.

As to frequencies, there appears to be no appreciable difference between the left and right hemispheres in our material. Nevertheless, the lunate appears to be more distinctly outlined on the left hemisphere and to extend farther on the lateral surface. This is reconcilable with Elliot Smith's later observation (Mott Memorial volume, '29), that the surface extent of the striate area is approximately the same in both hemispheres.

The apparent differences could be a matter of folding of the striate area and attention has already been drawn to the difference in the neighboring parietal cortex in the two hemispheres which might have an influence in this folding.

The medial surface. No detailed comparative study could be made of the medial surface of the brain as it was not desirable to separate the hemispheres in this series. However it was quite feasible to examine the medial surface of the occipital lobes in many of the hemispheres.

The anterior boundary of the occipital lobe on the medial surface is the parieto-occipital fissure. The fissure is anterior to the parastriate and peristriate areas (19 and 18 of Brodmann). The cortical areas have thus shifted more caudally than the fissure, compared to infra-human groups, according to the principle stated by Ariëns Kappers as previously mentioned.

The deep parieto-occipital fissure has several submerged sulci. These are exposed on the surface in most anthropoids in varying degrees, and are sometimes superficial in the human brain. Elliot Smith ('04) distinguished three furrows making up the parieto-occipital complex: the incisura parieto-occipitalis, the sulcus limitans praecunei and the sulcus paracalcarinus. The incisura crosses the dorsal margin and is axial to the arcus intercuneatus. This gyrus is limited anteriorly by the s. limitans praecunei, the fundamental part of the fissure, and posteriorly by the s. paracalcarinus. In most human brains, the gyrus intercuneatus is submerged in the parieto-occipital fossa, together with its limiting sulci so that a continuous fissure is seen on the surface. But the gyrus may partly emerge, exposing the dorsal terminations of the limiting sulci, giving the appearance of a forking of the parieto-occipital fissure, or rarely, the gyrus may be fully exposed, exposing all three limiting sulci. This is a simpler condition as it indicates a lack of development of the anterior and posterior opercula bordering the fissure. It has not been established that the three limiting sulci are homologous with the like-named sulci of the lower Primates.

In the great majority of the hemispheres in our series of both Negro and White a simple continuous parieto-occipital fissure is formed on the medial surface and this extends in varying degrees on the dorso-lateral surface. In some of the specimens, however, the constitutent sulci are exposed.

The appearance of the limiting sulci on the surface more frequently occurs in specimens which are also undeveloped on the lateral surface of the lobe. Or, in general, the greater the development of the operculum on the lateral surface, the less is the development of the parieto-occipital opercula on the medial surface.

Figure 39 shows the medial surface of the same brain as illustrated in figure 1, plate 1. The gyrus intercuneatus (ic) is largely exposed and the incisura (ipo) is separated from the s. limitans praecunei (lp) by a submerged gyrus. The paracalcarine (pc) is for the greater part exposed on the surface, its inferior portion only being operculated.

In figure 40 there is a greater opercularization, so that only the dorsal portions of the sulci are exposed. There are likewise more sulci in this specimen, namely a s. cunei (cu) and limiting sulci, superior (ls) and inferior (li) of the area striata. In both figures a very simple unbranched retrocalcarine (rc) is seen.

The basal surface. In a previous study (the writer, '36) we have seen than in some of the lower Primates, a single sagittal sulcus may be present on the ventral surface, terminating posteriorly near the caudal end of the retrocalcarine fissure. The sulcus gives rise to two independent sagittal furrows, the true collateral and the occipito-temporal. The parent sulcus is usually referred to as the collateral, but sometimes as the occipito-temporal. The single furrow may fork, the caudal stem and medial branch forming the true collateral and the lateral branch the temporo-occipital. Two independent furrows arise by their complete separation. In their further development the collateral sulcus extends anteriorly, while the occipito-temporal is prolonged posteriorly, from a point just lateral to the rhinal fissure back to the caudal part of the brain

where it may join the inferior occipital. Medial to the collateral is the sulcus of the gyrus lingualis (lg). The occipito-temporal may likewise branch or break up into several overlapping segments, especially in the higher Primates.

At first sight the basal aspect of the brain in anthropoids appears almost as well fissurated as the human. This impression is somewhat illusory. It may be noted that the retro-calcarine fissure in anthropoids is visible for the greater part of its course, on the tentorial surface. This adds to the apparent richness of the fissuration. In the human brain there is a great development of the inferior temporal lobe which grows downward and pushes the cortex medially. The retro-calcarine is thus pushed more to the medial aspect of the brain, and only its anterior part is usually visible on the ventral aspect of the brain.

According to Elliot Smith, the collateral sulcus in the human brain is a limiting sulcus between the area peristriata and the area occipito-temporalis. From its caudal part, a sulcus extends forward and laterally, forming with the s. collateralis a V-shaped pattern. It limits the same areas as the main sulcus and is hence called the transverse collateral.

In the human brain a new area, the occipito-temporalis (37 of Brodmann) is wedged in between the temporal inferior (20 of Brodmann) in front and the peristriate area (19 of Brodmann) caudally. The area is apparently more extensive on the basal surface and pushes the peristriate nearer the occipital pole.

The area occipito-temporalis probably shows much individual variation as the transverse collateral is a very inconstant fissure and often non-identifiable in our specimens. The posterior part of the basal surface in general is very variable and homologies would be difficult to establish.

To illustrate some variations of the fissures on the basal aspect of the brain, two figures are shown of the smallest specimens in our series. Figure 41 is that of a Negro brain. On the left hemisphere the rhinal posterior (rp) is superficially concurrent with the incisura temporalis (it) and separated on the

right hemisphere. The tendency of the anterior part of the parent occipito-temporal fissure to anastomose with each of its products, the temporal inferior (ti) and the collateral (col) is well seen in both hemispheres.

The temporal inferior, or as it is better termed, the occipito-temporal is continuous caudally and united with the incisura prae-occipitalis (ipr) which ascends on the lateral surface. The incisura when present cuts deep into the ventral border, but it is inconstant even as to position. More frequently the temporal inferior breaks up into overlapping segments.

The collateral sulcus in both hemispheres is a continuous branched furrow.

Figure 42 shows the basal aspects of a White brain. Attention is drawn to the contour of the brain surface in this figure, which is typical of our White series, as compared with that of the Negro, the White showing a greater breadth compared to length. There are a few more transverse sulci in this specimen, and in general a slightly greater degree of fissuration. The difference in the degree of fissuration on the basal surface in the Negro and White of the whole series, is about the same as represented in the figures, though in some specimens the difference is slightly greater.

SUMMARY

1. Description and illustrations have been given of a series of occipital lobes of Negro and White brains, beginning with the simplest types of fissuration and ascending to the more complex.

2. The s. lunatus in the human brain, as the approximate anterior boundary of the striate area, is considered to be the homologue of that occurring in other Primates.

3. The same may be said in general for the associated sulci, as the retrocalcarine and lateral calcarine, as judged by their topographical relations.

4. The characteristic concentric form of the lunate is less frequently present than a more irregular type and leaves no

doubt as to its morphological equivalent to that in the infrahuman.

5. The opercularization by the posterior lip of the lunate is considerable in some specimens, but does not attain the degree necessary to form a complete "Affenspalte."

6. The frequency of the lunate sulcus is not appreciably different in the left and right hemisphere, though the sulcus may be more frequently of the typical form and extend more laterally on the left hemisphere than on the right.

7. The dorso-ventral extension of the striate area produces the superior polar sulcus which is not a dorsal part of the true lunate, but an independent sulcus. The two sulci, however, may be superficially concurrent, forming a continuous arched furrow and both approximately limit the striate area.

8. The lunate is frequently separated into two parts, dorsal and ventral by a translunate gyrus. With their respective prelunates they form the lateral occipital sulci.

9. A reciprocal relation exists between the retrocalcarine and the lateral calcarine and these two with the polar sulci. An extension of the retrocalcarine on the lateral surface results in the disruption of the lateral calcarine. With the pushing of the striate area toward the medial border, the branches of the lateral calcarine spread apart, and they separate to form a vertical calcarine, while the retrocalcarine remains on the medial surface.

10. The lateral calcarine is a distinct sulcus from that separated off from the retrocalcarine by the emergence of the posterior cuneo-lingual gyrus.

11. The series of Negro and White hemispheres has been divided into five groups, according to the form of the lunate and the degree of the extension of the operculum, its separation into two parts, its dissolving into fragments, or finally its being non-identifiable.

12. A larger percentage of group 1, with the typical crescentric form of the lunate sulcus was found in Negro hemispheres.

13. The irregular, wavy form, with a more vertical position, of the lunate occurs in the hemispheres of the White brain.

14. The s. lunatus, is present in most human brains, either as a continuous sulcus of varying form, or divided into two parts. Fragments may be identifiable with a certain degree of probability from their depth and topographical relations.

15. The gyrus intercuneatus on the medial surface is not operculated in some specimens, especially in those that show a considerable development of the operculum on the lateral surface.

16. The basal aspects of the brain show much variation in detail especially in the caudal part.

17. The ventral surface is somewhat more fissurated in our series of White than in the series of Negro hemispheres.

18. No particular morphological feature of the occipital lobe was found to be characteristic of the Negro brain as distinguished from the White. The differences are the relative frequencies of the morphological features.

GENERAL CONCLUSIONS

In this comparative morphological study of the fissural pattern of the human brain as represented by White (German) and Negro brains, summaries were given at the end of each part, dealing with the frontal, temporal and parietal, and the occipital lobes, and need not be repeated here.

As to racial differences no morphological feature was found to be exclusively characteristic of either the White or Negro brain. It would be quite erroneous, however, to conclude from this fact that cerebral differences do not exist in the two races. There is first of all a difference in the frequencies of morphological features in the sulcal pattern such as has been illustrated for the occipital lobe. The differences in frequencies combined with other morphological features such as the shape of the brain and the relative size of its parts are of anthropological significance.

But different frequencies of the features do not enable us to tell the racial provenience of an individual specimen. There remains the possibility that combinations of morphological features produce a configuration of the fissural pattern typical of each race. There is some foundation for this view. The course of the sulci often differs somewhat in our two series, a fact which is correlated with the shape of the brain. But again many exceptions occur and this feature alone could not serve as a criterion of racial differences. It may be possible, however, by considering the more typical sulcal features in each race together with other morphological features such as the shape of the brain and its parts, form of the temporal pole, etc., to determine the race to which an individual specimen belongs, in a goodly percentage of cases.

The fissuration in our White series is somewhat greater than in the Negro series. Taking the brain as a whole, there is only a slight correlation between the degree of fissuration and size of brain. In small weight differences the lighter brain may be the better fissured.

It is obvious from the study of our material that there is a great overlap in the variability of the sulcal features. But it is likewise true that the range of variation is not the same in the two races as represented in our series. In considering each of the lobes of the brain, the writer began with the description of the simplest brain in the series, namely that of a male Negro brain weighing 921 gm. (U.S.N.M. 228045). In each lobe the fissural pattern of this brain is very primitive and there is no equivalent to be found in our White series. The same may be said of a female Negro brain weighing 1056 gm. (U.S.N.M. 290085) which is somewhat less primitive but still below the range of the White series.

It is quite possible that further study of other White brains might show specimens equally primitive as these two Negro brains. In any case the retention of primitive morphological features is not known to have any mental correlate.

U. S. National Museum numbers with sex and weights of brains illustrated in the description of the frontal, parietal and temporal, and/or occipital lobes.

NEGRO Weight gm.	NEGRO Sex	NEGRO U.S.N.M.	WHITE Weight gm.	WHITE Sex	WHITE U.S.N.M.
921	♂	228045	1000	–	225310
930	♀	289803	1075	♀	258850
1009	♂	228868	1141	♂	272450
1023	♂	289013	1166	♂	258313
1056	♀	290085	1175	♂	258858
1134	♀	289804	1195	♂	272457
1145	♂	228482	1195	♂	258309
1148	♀	219398	1210	♀	258852
1165	♂	289011	1220	♀	258854
1205	♂	290083	1220	♂	270979
1207	♀	287012			
1209	♀	228040	1300	♂	270983
1232	♂	295502	1330	♂	258321
1239	♂	(293)	1360	♀	258860
1254	♂	289805	1384	♂	272461
1290	♂	253769	1442	♂	270995
1322	♂	289802	1460	♂	270985
1355	♂	289010	1489	♂	272454
1450	♂	228175	1497	♂	227449

LITERATURE CITED

ANTONI, N. R. E. 1914 Ausbreitung u. Flächenbeziehungen der area striata im menschlichen Gehirn. Folio. Neurobiologica., vol. 8, p. 265.

ARIËNS KAPPERS, C. U., G. C. HUBER AND E. C. CROSBY 1936 The Comparative Anatomy of the Nervious System of Vertebrates including Man. II. New York.

BOLTON, J. S. 1900 The exact histological localization of the visual area. Phil. Trans. Roy. Soc. London. Series B., vol. 193, p. 165.

BRODMANN, K. 1925 Vergleichende Lokalisationslehre der Grosshirnrinde. 2te. Auflage, Leipzig.

CONNOLLY, C. J. 1936 The fissural pattern of the Primate brain. Am. J. Phys. Anthrop., vol. 21, p. 301.

v. ECONOMO, C. 1930 Zur Frage des Vorkommens der Affenspalte beim Menschen im Lichte der Cytoarchitektonik. Ztschr. f. d. ges. Neurol. u. Psychiat., vol. 30, p. 419.

GRATIOLET, P. 1854 Mémoire sur les plis cérébraux de l'homme et des Primates. Paris.

INGALLS, N. W. 1914 The parietal region in the Primate brain. J. Comp. Neur., vol. 24, p. 291.

KUHLENBECK, H. 1928 Bemerkungen zur Morphologie des Occipitallappens des menschlichen Grosshirns. Anat. Anz., vol. 65, p. 273.

LEVIN, G. 1936 Racial and ''inferiority'' characters in the human brain. Am. J. Phys. Anthrop., vol. 22, p. 345.

MURPHY, J. B. 1910 Note on the sulcus lunatus in Negro and White Brains and its relation to the area striata. Anat. Rec., vol. 4, p. 115.

POYNTER, C. W. M., AND J. J. KEEGAN 1915 A study of the American Negro brain. J. Comp. Neur., vol. 25, p. 183.

RETZIUS, G. 1896 Das menschenhirn. Jena.

SERGI, S. 1908 Sul limite posterior del lobo parietale e sui solchi occipitali esterni nel cervello dell' uomo. Atti Soc. Romana Anthrop., vol. 14, p. 75.

SHELLSHEAR, J. L. 1937 The brain of the aboriginal Australian. Phil. Trans. Roy. Soc. London, Series B., vol. 227, p. 293.

SMITH, G. ELLIOT 1903 The so-called ''Affenspalte'' in the human (Egyptian) brain. Anat. Anz., vol. 24, p. 74.

——— 1904 Studies in the morphology of the human brain with special reference to that of the Egyptians. Records of Egyptian Gov. Sch. Med., vol. 2, p. 124.

——— 1929 The variations in the folding of the visual cortex in man. Mott Memorial Volume. Contributions to Phychiatry, Neurology and Sociology, London.

ZUCKERKANDL, E. 1904 Über die Affenspalte und des Operculum occipitale des menschlichen Gehirns. Arb. neurol. Inst. Wien., vol. 12, p. 207.

PLATES

ABBREVIATIONS

ip, s. intraparietalis
po, s. parieto-occipitalis
par, s. paroccipitalis
otr, s. occipitalis transversus
L, s. lunatus
pl, s. praelunatus
pm, s. paramedialis
s, s. polaris superior
i, s. polaris inferior
a^3, s. occipitalis anterior
ipr, incisura praeoccipitalis
ipo, incisura parieto-occipitalis
lp, s. limitans praecunei
it, incisura temporalis
rp, s. rhinalis posterior
ts, s. temporalis superior
tm, s. temporalis medius
ti, s. temporalis inferior
col, s. collateralis
ctr, s. collateralis transversus
ca,rc,pc, s. calcarinus, retrocalcarinus, paracalcarinus
cv, s. calcarinus verticalis
lc, s. calcarinus lateralis; branch
u, ramus superior
ac, s. calcarinus accessorius

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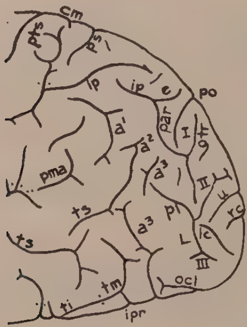

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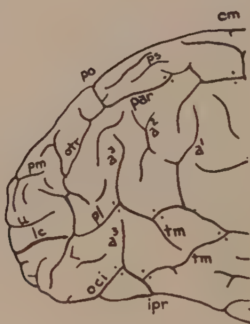

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1 Left occipital lobe of a Negro brain weighing 921 gm. ♂.
2 Right occipital lobe of same brain.
3 Left occipital lobe of a Negro brain weighing 1056 gm. ♀.
4 Right occipital lobe of the same brain.
5 Left occipital lobe of a Negro brain weighing 1148 gm. ♀.
6 Right occipital lobe of the same brain.

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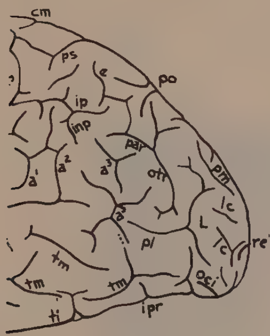

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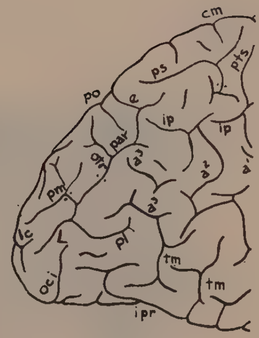

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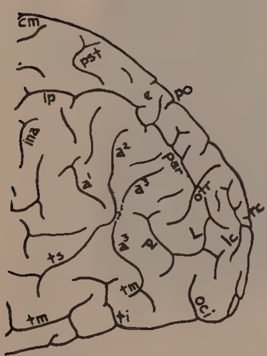

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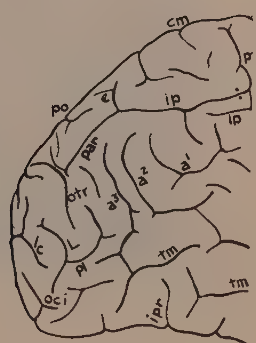

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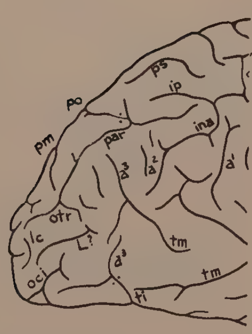

7 Left occipital lobe of a White brain weighing 1195 gm. ♂.
8 Right occipital lobe of the same brain.
9 Left occipital lobe of a White brain weighing 1220 gm. ♂.
10 Right occipital lobe of same brain.
11 Left occipital lobe of a White brain weighing 1166 gm. ♂.
12 Right occipital lobe of same brain.

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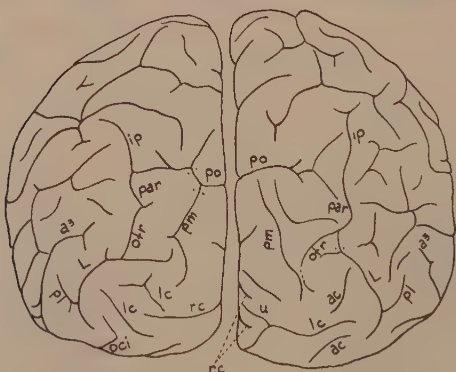

13 Photograph of a Negro brain weighing 1239 gm. ♂.
14 Drawing of the same brain.

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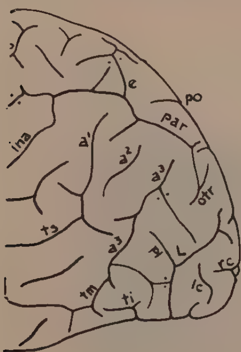

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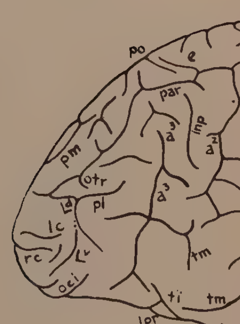

15 Left occipital lobe of a Negro brain weighing 1355 gm. ♂.
16 Right occipital lobe of same brain.
17 Left occopital lobe of a Negro brain weighing 1023 gm. ♂.
18 Right occipital lobe of same brain.
19 Left occipital lobe of a Negro brain weighing 1232 gm. ♂.
20 Right occipital lobe of same brain.

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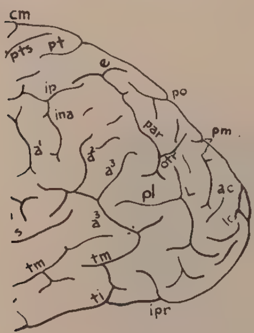

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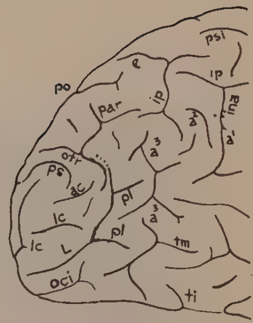

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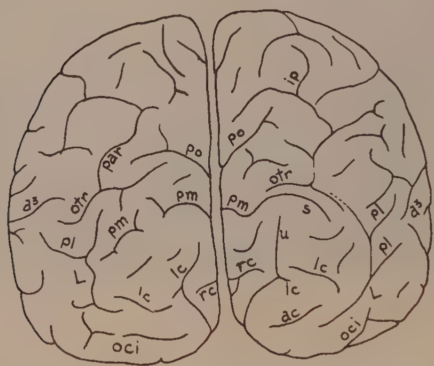

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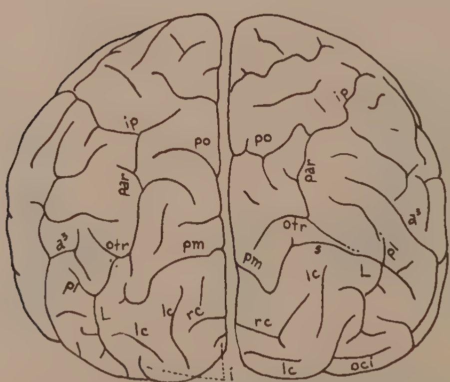

21 Left occipital lobe of a White brain weighing 1175 gm. ♂.
22 Right occipital lobe of same brain.
23 Occipital view of same brain.
24 Occipital view of White brain weighing 1384 gm. ♂.

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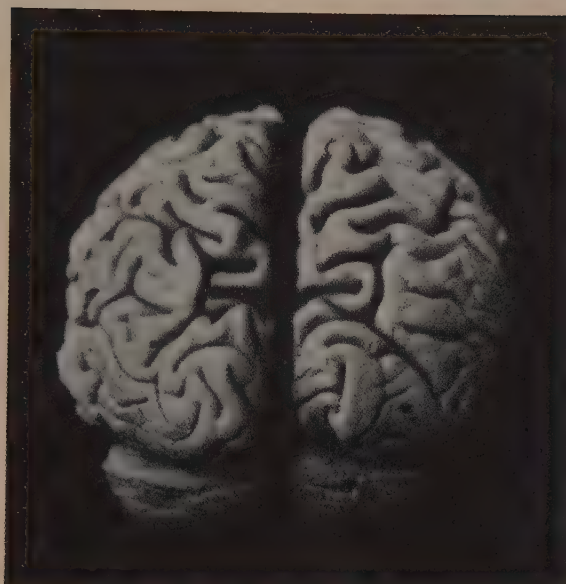

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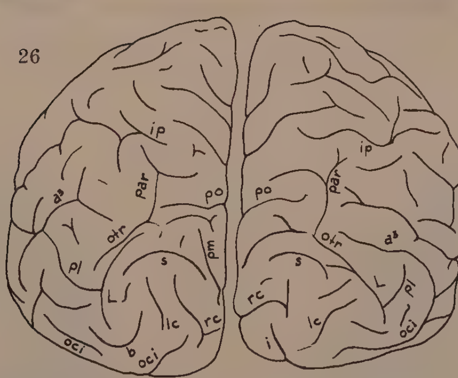

25 Photograph of White brain weighing 1195 gm. ♂.
26 Drawing of same brain.

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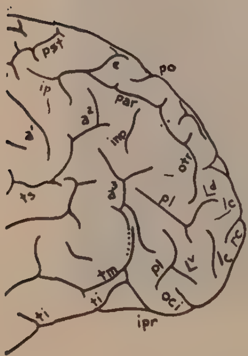

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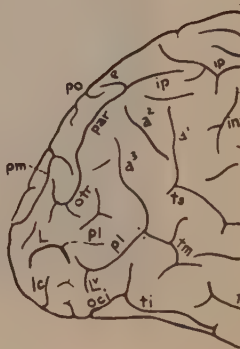

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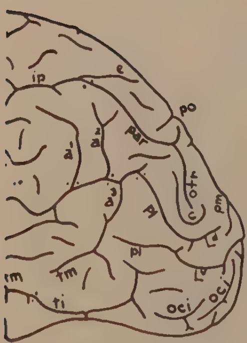

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27 Left occipital lobe of Negro brain weighing 1009 gm. ♂.
28 Right occipital lobe of same brain.
29 Left occipital lobe of Negro brain weighing 12005 gm. ♂.
30 Right occipital lobe of same brain.
31 Left occipital lobe of Negro brain weighing 1450 gm. ♂.
32 Right occipital lobe of same brain.

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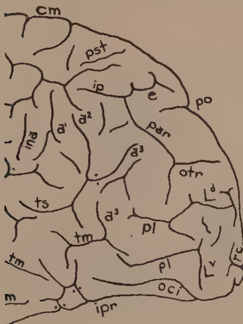

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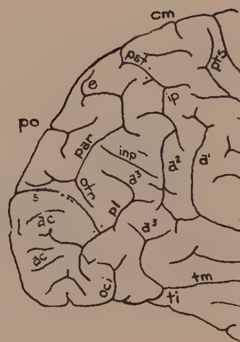

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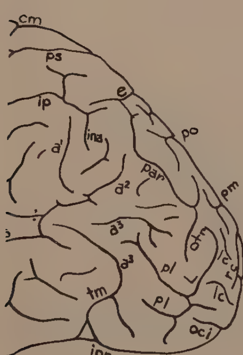

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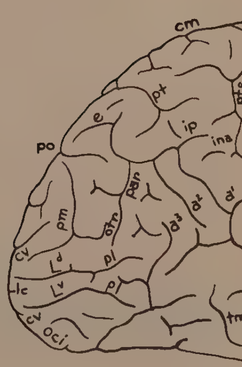

33 Left occipital lobe of White brain weighing 1360 gm. ♀.
34 Right occipital lobe of same brain.
35 Left occiptal lobe of White brain weighing 1220 gm. ♀.
36 Right occipital lobe of same brain.
37 Left occipital lobe of White brain weighing 1497 gm. ♂.
38 Right occipital lobe of same brain.

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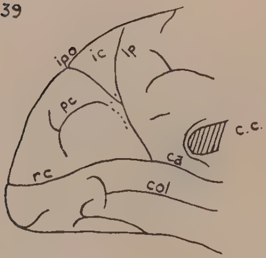

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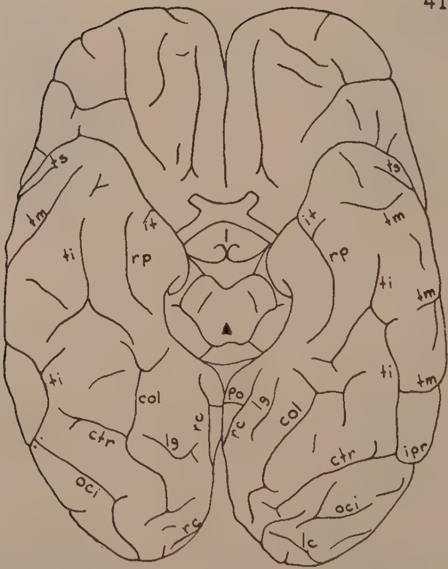

39 Medial view of left occipital of Negro brain weighing 921 gm. ♂.
40 Medial view of right occipital lobe of White brain weighing 1000 gm.
41 Basal aspect of Negro brain weighing 921 gm.

42 Basal aspect of White brain weighing 1000 gm.

DEGREE OF KINSHIP AND PATTERN OF OSSIFICATION

A LONGITUDINAL X-RAY STUDY OF THE APPEARANCE PATTERN OF OSSIFICATION CENTERS IN CHILDREN OF DIFFERENT KINSHIP GROUPS [1]

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A number of studies have indicated a genetic or familial basis for certain skeletal resemblances. As long ago as 1907, Pryor ('07) stated that the variations in the ossification of bones were inherited. His conclusions were based on a study of carpal sequence and on the presence of extra epiphyses in members of the same family. His later studies ('36, '39) have confirmed his belief.

X-ray studies of ossification centers in twins and other multiple births have been of value in bringing forth evidence of hereditary influences. Buschke ('34, '35) has been outstanding in this field. Other studies dealing, at least in part, with ossification in closely related children include those by Lund ('33), Hess and Abramson ('33), Flory ('36), Key ('36) and Rigler ('38).

The general weight of opinion seems to favor the probability that some genetic factors are certainly at work, to account for the distinct similarities to be found in the skeletal framework of identical twins, as compared to dissimilarities found in fraternal twins. Many such studies, however, concentrate on evidence gained from what may be called a static analysis of x-ray findings; that is, base their conclusions primarily on an examination of a single film for each case, or at most on a

[1] These data formed the basis of an A.M. thesis, written for the Department of Anthropology, University of Chicago.

very few. They deal mainly with anatomical resemblances and identical skeletal anomalies in closely related children, at one period of time. Such studies of necessity lack the evidence which x-rays taken at different age-levels on the same children afford, and also lack such controls as would be given by a similar study on an unrelated population.

MATERIAL AND METHODS

The present study is an attempt to determine whether the patterns of appearance of skeletal epiphyses are more similar in related children than in unrelated children. It is also concerned with the degree of kinship, attempting to determine whether identical twins, for example, are more similar in their patterns of ossification than are ordinary siblings, or first cousins.

The cases selected, on the basis of completeness of data, from the long-time longitudinal study of human growth underway at the Fels Research Institute, fall into the following kinship categories: One set of identical triplets, three pairs of identical twins; twenty-two pairs of siblings; eight pairs of first cousins; eighteen unrelated children.

The triplets have been designated as dichorionic monozygotic by Sontag and Nelson ('33), and their findings were corroborated on a basis of ossification by Pryor ('36). This trio was treated as three pairs of identical twins for the purposes of this study. The other three pairs of identical twins were so designated on the basis of criteria considered to be direct evidence in favor of monozygotic origin (Lund, '33, p. 31). The unrelated children were paired without selection other than sex, forming three pairs of unrelated girls, three pairs of unrelated boys, and three unrelated pairs of opposite sex.

Onset of ossification, in this paper, is defined as the estimated time at which an ossification center appears, as judged by its first visible shadow on the x-ray plate. The thirty-eight centers chosen for this study were selected so as to be repre-

sentative both anatomically and in time of appearance from birth to around 78 months. These centers, listed in the mean order of their appearance for Fels boys (essentially the same order for girls), are shown below:

1. Cuboid
2. Head of humerus
3. Capitate
4. Distal tibia
5. Head of femur
6. Lateral cuneiform
7. Capitulum
8. Gt. tuberosity humerus
9. Distal fibula
10. Distal radius
11. Prox. 3rd finger
12. Distal 1st toe
13. Distal 1st finger
14. Prox. 3rd toe
15. Metacarpal III
16. Medial cuneiform
17. Middle 3rd finger
18. Triquetral
19. Metartarsal I
20. Distal 3rd finger
21. Middle cuneiform
22. Metacarpal I
23. Prox. 1st toe
24. Navicular (foot)
25. Prox. 1st finger
26. Metartarsal III
27. Gt. trochanter femur
28. Lunate
29. Prox. fibula
30. Patella
31. Distal 3rd toe
32. Navicular (hand)
33. Prox. radius
34. Greater multangular
35. Lesser multangular
36. Medial epic. humerus
37. Distal ulna
38. Epiphysis calcaneus

Pyle and Sontag ('43) have given the mean time of appearance for these and other centers, for the Fels series, together with a description of the methodology employed in the appraisal of x-rays. The mean time of appearance ranged, for boys, from birth to 90 months; for girls, from birth to 64 months.[2]

X-ray films are available on the Fels children at birth, 1, 3, 6, 9 and 12 months, and every 6 months thereafter. At each of these age levels, the films for each child are examined, and the estimated onset time of each visible center tabulated. This estimated time of appearance is transformed into a score which is directly comparable with the values for the other centers in the same child, and with the values for other children. This is done by calculating standard scores for each onset time for each child.[3] These standard scores are plotted onto individual records.

[2] The study of the triplets was begun at the Fels Research Institute when these children were 36 months old. For this reason the centers included in their series do not entirely coincide with the thirty-eight mentioned above, twelve others being added to secure an adequate sampling.

[3] The formula for this operation is: standard score $= \frac{X-M}{s.d.}$, where X is an estimated onset time for a certain center, and M and s.d. are the mean and standard deviation, respectively, of that distribution. (Lindquist, '38, pp. 129–134).

The present study may be divided conveniently into the following sections:

(1) Correlation of paired children, by onset of corresponding centers. This will include distribution by kinship groups of the values obtained; the derivation of group values, and a test of their significance; a test of the significance of the differences between these group values; conclusions.

(2) Comparisons of differences between extremely deviant centers and their corresponding centers in the paired child. This will include a presentation of mean differences found, by kinship groups; a test of the significance of these differences; conclusions.

(3) Comparisons by ''precedence patterns'' of ossification. This will include a definition of the term; a discussion of the methods to be employed; a presentation of differences in concordance of the precedence patterns, by kinship groups; conclusions.

RESULTS

1. Correlation of paired children, by onset of corresponding centers

The Pearson coefficient of correlation (r) between the onset times of two children (using standard scores) will give a value which represents the degree of association between these children in terms of their individual patterns of ossification. If the two patterns are very similar, that is, have the same shape when plotted, or lie parallel to each other, a high positive r may be expected. If, on the other hand, there is no resemblance between the two patterns, or if they tend to diverge in opposite directions, a near-zero or a minus r will be found. The responsiveness of r to the shapes of the onset patterns of paired children forms the basis of the present section of the study. The distribution of the coefficients obtained, within each kinship category, are shown in table 1.

By use of the z-method of Fisher ('32, p. 183), the array of values within each kinship group was combined to give a representative r for the group. The position of the group r

is indicated by the arrows in table 1, while the actual value of each group r is presented in table 2, together with the Fisher ('32, p. 171) test of significance of r from zero.

TABLE 1

Distribution of correlation coefficients (r) of onset patterns for paired children, by kinship group.

KINSHIP GROUP	NO. PAIRS	RANGE OF $+r$										RANGE OF $-r$				
		91–100	81–90	71–80	61–70	51–60	41–50	31–40	21–30	11–20	1–10	1–10	11–20	21–30	31–40	41–50
Identical twins	6	1	1	√	1	.	1	1	1	.	.	.	.	.	.	.
Siblings	22	.	.	..	.	2	3	2	√7	4	2	.	.	1	1	.
First cousins	8	.	.	..	.	.	.	1	2	√1	2	1	1	.	.	.
Unrelated pairs	9	.	.	..	.	.	1	.	.	1	2	√2	1	1	.	1

√ = group r, after Fisher ('32, p. 183).

TABLE 2

Group r of onset patterns of paired children, by kinship groups, and tests of significance.

GROUP KINSHIP	N	r	t [1]	PROBABILITY OF CHANCE OCCURRENCE [1]	SIGNIFICANTLY DIFFERENT FROM ZERO CORRELATION ?
Identical twins	178	.71	13.40	Less than 1/100	Yes
Siblings	666	.28	7.48	Less than 1/100	Yes
First cousins	256	.12	1.92	5/100	Yes
Unrelated pairs	274	—.01	.17	90/100 to 80/100	No

[1] See Fisher ('32, pp. 151, 171).

The twins, with a group r of + .71, show very definitely the closest association of onset patterns, followed by the siblings with a group r of + .28 and the cousins with a group r of + .12. The group r for the unrelated children was — .01.

Fisher's test indicates that the group r for each of the three related groups is significantly different from zero; that is, such an r could be obtained by chance in a population in which there was no correlation only five (or less) times in a hundred. The unrelated children, however, cannot be distinguished statistically from a group having zero correlation.

In table 3, the significance of the differences between the group r's, as determined by the method of Fisher ('32, p. 182), is shown.

All the differences are statistically significant except the difference between the cousins and unrelated children, which approaches significance. This indicates that it is unlikely that these kinship groups represent the same population.

TABLE 3

Significance of differences between group r's, by kinship groups.

KINSHIP GROUPS COMPARED	DIFFERENCE ± SIGMA [1]	SIGNIFICANT?
Identical twins and siblings	.6072 ± .084	Yes
Identical twins and first cousins	.6777 ± .097	Yes
Identical twins and unrelated pairs	.9032 ± .096	Yes
Siblings and first cousins	.1705 ± .073	Yes
Siblings and unrelated pairs	.2960 ± .072	Yes
First cousins and unrelated pairs	.1255 ± .087	No (near)

[1] See Fisher ('32, p. 182).

We may now consider a possible interpretation of the above results. There is no doubt that, both in terms of distribution of r within each kinship group, and with reference to the position of the group r, there is a differentiating factor at work between the kinship groups. Pairs of more closely related children tend to have onset patterns that are more similar.

Moreover, the three groups of related children are unlikely to have come from populations in which there was no correlation between onset patterns of paired children, while the unrelated group is very likely to have come from such a population.

Finally, the related groups are very likely to represent different populations from each other, and (except for cousins versus unrelated children) with the unrelated controls.

The entire picture is in conformity with the pattern to be expected from a genetic interpretation.

2. Comparisons of differences between extremely deviant centers and their corresponding centers in the paired child

We have considered, by the correlation technique, the relationships existing between the total onset patterns of paired children; it may now be profitable to consider, not the patterns as a whole, but the individual centers of ossification, particularly those centers which are extremely deviant in time of appearance.

The procedure followed in this section is as follows: The standard scores for the entire series were inspected, and those centers chosen which had a deviation from the group norm of more than ± 2 standard deviations. At the same time, the value of the corresponding center in the paired child was recorded. The difference between these two values was taken, and the mean of such differences, within each kinship group, was obtained.

To give an example, if child A has the onset of the patella quite late, at a time which represents $+2.6$ sigmas from the group mean for that center, while his partner, child B, has the onset of this center slightly early, at $-.2$ sigma, then the difference between the two values is 2.8 sigmas, and is so recorded. The difference between each deviant center and its corresponding center in the paired child is so obtained, and the mean difference obtained for each of the kinship groups. Table 4 shows the results of such comparisons.

TABLE 4

Means of differences between deviant centers and their corresponding centers, by kinship groups.

KINSHIP GROUP	NUMBER OF PAIRED CENTERS	MEAN ± SIGMA OF MEAN
Identical twins	19	.38 ± .20
Siblings	31	2.03 ± .21
First cousins	35	2.69 ± .21
Unrelated pairs	49	3.23 ± .20

The twins, with a mean difference of .38 sigma, show by far the smallest value, followed by the siblings with 2.03 sigmas, the cousins with 2.69 sigmas, and the unrelated children with 3.23 sigmas.

The significance of the differences between these means, by kinship groups, as indicated by the critical ratio (Guilford, '36, pp. 51, 60) is shown in table 5.

All differences between kinship groups are statistically significant, except that between cousins and unrelated children (borderline).

TABLE 5

Significance of differences between mean differences, by kinship groups.

KINSHIP GROUPS COMPARED	DIFFERENCE BETWEEN MEANS	CRITICAL RATIO	SIGNIFICANT?
Identical twins and siblings	1.65	5.7	Yes
Identical twins and first cousins	2.31	8.0	Yes
Identical twins and unrelated pairs	2.85	10.2	Yes
Siblings and first cousins	.66	2.2	Yes
Siblings and unrelated pairs	1.20	4.1	Yes
First cousins and unrelated pairs	.54	1.9	No

Again previous sequences duplicate themselves. The more closely related children show less difference between the value of a deviant center and the value of its corresponding center in the paired child. As the degree of kinship decreases, the difference between the two values tends to increase.

The evidence brought forward by this method of comparison indicates that corresponding centers in pairs of closely related children, particularly in identical twins, tend to "hang-together" to a greater degree than in unrelated children.

An interpretation of this characteristic once again seems most easily made by recognizing a genetic factor which differentiates the kinship groups.

3. Comparisons of "precedence patterns" of ossification

Another method of comparing possible differences between the kinship groups is to segregate small units of the total

onset pattern, and to examine agreement or disagreement in order of onset, for paired children, within these smaller divisions.

When the group norm for the appearance time of three different ossification centers is approximately the same, any one of these centers could appear first in an individual child, without causing comment. Designating such three centers as 1, 2, and 3, one would not be surprised to see the sub-pattern of ossification for a child fall into any one of six possible combinations, in terms of order of appearance — 1, 2, 3; 1, 3, 2; 2, 1, 3; 2, 3, 1; 3, 1, 2; 3, 2, 1. Similarly, for the partner of this child, the same six possibilities of order of onset occur. These abbreviated onset sequences are called, in this paper, the "precedence patterns" within the total onset picture.

Now, if no influence other than chance is operating between two paired children, for any precedence pattern of the above three centers for one child, any one of six precedence patterns could occur for the other child. In other words, if only chance determines agreement or disagreement in the two precedence patterns, they should by chance agree once in six times, on the average, and disagree in five out of six cases.

This situation offers another opportunity to compare the kinship groups, on the basis of amount of agreement between paired precedence patterns. There are available, among the thirty-eight ossification centers with which we are dealing, two such trios of centers which are close enough together in mean time of onset to permit an investigation of their so-called precedence patterns. These two trios are: metatarsal I, distal third finger, middle cuneiform; and navicular, greater multangular, lesser multangular.

The procedure followed in the present section is as follows: for each pair of children, corresponding precedence patterns were inspected, and tabulated as either agreeing or disagreeing in order of onset. The results of these comparisons are shown in table 6.

Twins showed distinctly more agreement than would be expected if chance were the only factor operating, in which

latter case only 17% of the patterns should agree. So too the siblings, with agreement in 44% of the comparisons, and the cousins, with 33% agreement, were well above the expected value. The unrelated children showed agreement in precedence patterns in 13% of the comparisons.

It appears that the higher percentage of agreement in the more closely related kinship groups, and the nearly normal representation in the unrelated groups, indicate a selective factor working within the kinship groups. This selection is most easily accounted for on a genetic basis.

TABLE 6

Agreement in precedence patterns of ossification, by kinship groups.

KINSHIP GROUP	NO.	AGREEMENT	DISAGREEMENT	PERCENT AGREEMENT		ODDS	
				Actual	Expected	Actual	Expected
Identical wins	9	6.5	2.5	72	17	4.3 : 6	1 : 6
Siblings	35	15.5	19.5	44	17	2.7 : 6	1 : 6
First cousins	15	5.0	10.0	33	17	2.0 : 6	1 : 6
Unrelated pairs	15	2.0	13.0	13	17	.8 : 6	1 : 6

SUMMARY AND CONCLUSIONS

1. Four kinship groups were selected from the Fels Research Institute series: identical twins (6 pairs); siblings (22 pairs); first cousins (8 pairs); unrelated children (9 pairs).

2. An attempt was made to determine whether the pattern of appearance of certain ossification centers was more similar between related than between unrelated children; and in addition whether a differential existed among the three related groups.

3. Pairs of more closely related children tend to have onset patterns that are more similar. The ranking from greatest to least similarity in pattern is: twins, siblings, cousins, unrelated children.

4. Pairs of more closely related children tend to have deviant centers which are more similar in time of onset to their corresponding centers. The ranking from greatest to least simi-

larity in deviation pattern is: twins, siblings, cousins, unrelated children.

5. Pairs of more closely related children tend to have subgroups of ossification centers which are more similar in order of appearance. The ranking from greatest to least similarity in precedence pattern is: twins, siblings, cousins, unrelated children.

6. This consistent hierarchy of resemblances points to some selective factor operating within the kinship groups.

7. It is suggested that this selective factor is heredity operating upon both time and order of onset of ossification centers in the body.

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LITERATURE CITED

BUSCHKE, F. 1934 Roentgenologische Skelettstudien an Menschlichen Zwillingen und Mehrlingen. Leipzig.

——— 1935 The radiological examination of the skeleton of triplets. J. Hered., vol. 26, pp. 391–410.

FISHER, R. A. 1932 Statistical Methods for Research Workers. Edinburgh.

FLORY, C. D. 1936 Osseous development in the hand as an index of skeletal development. Monog. Soc. Res. Child Develop., vol. 1, no. 3, 141 p.

GUILFORD, J. P. 1936 Psychometric Methods. New York.

HESS, A. F., AND H. ABRAMSON 1933 Familial retardation in ossification of the carpal centers. J. Pediat., vol. 3, pp. 158–165.

KEY, W. E. 1936 Radiological studies of the skeletons of twins, triplets and quadruplets. J. Hered., vol. 27, pp. 86–88.

LINDQUIST, E. F. 1938 A First Course in Statistics. Boston.

LUND, S. E. T. 1933 A psycho-biological study of a set of identical girl triplets. Human Biol., vol. 5, pp. 1–34.

PRYOR, J. W. 1907 Hereditary nature of variation in ossification of bones. Anat. Rec., vol. 4, pp. 84–88.

——— 1936 Ossification as additional evidence in differentiating identicals and fraternals in multiple births. Am. J. Anat., vol. 59, pp. 409–423.

——— 1939 Normal variations in the ossification of bones. J. Hered., vol. 30, 249–255.

Pyle, Idell, and L. W. Sontag 1943 Variability in onset of ossification in epiphyses and short bones of the extremities. Am. J. Roentg. and Radium Ther., vol. 49, pp. 795–798.

Rigler, L. G. 1938 Roentgen studies of twins and triplets. Radiology, vol. 30, pp. 461–470.

Sontag, L. W., and V. L. Nelson 1933 A study of identical triplets. J. Hered., vol. 26, pp. 473–480.

STUDIES IN THE PHYSICAL DEVELOPMENT OF NEGROES

III. CEPHALIC INDEX

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INTRODUCTION

The cephalic index (breadth × 100/length) measures the shape rather than size of the head. However, the growth in shape is of considerable anthropological interest. In point of fact, there does not exist as yet a statistically valid follow up series on adults remeasured over a protracted period of time up to old age and permitting a conclusive answer to the question of whether the size and shape of the head do change during the entire life span.

All my data on this index represent single measurements.

I made head measurements on Whites[1] and Negroes in New York during 1935 and again on Negroes in 1941. The material of my older Negro series, representing an unselected population, was obtained from the following sources: The Colored Orphans Asylum, Riverdale, New York; the clinics of the Harlem Health Center and Harlem Hospital; two public schools; such organizations as the Y.W.C.A., the Urban League and Girl Scouts; and the Municipal Lodging House, all of New York City. Visits were also made to Negro homes in a study of siblings.

The series of 1941 includes only individuals who were under the dietary regime of the Health Department of New York City, from birth to 4 years of age and over. The idea under-

[1] The findings on Whites are not tabulated in the present study. See Boas, ('35, '40).

lying this selection was the view, held by many observers, that not until 4 years of age do the head proportions become fairly stabilized.

The observations of 1935 are given in table 1 both compared and combined with those of Melville J. Herskovits ('30); and my findings of 1941 are compared with Herskovits' material in table 3.

In the present study, the following problems receive attention: (1) The change in the cephalic index from infancy to adulthood; (2) the difference in sex; (3) general comparison between Whites and Negroes; (4) attempts to determine whether secular changes can be noticed in my material of 1935 and 1941 by comparing these series with Herskovits' measurements of 1923 to 1926.

AGE, SEX AND RACE DIFFERENCES IN THE CEPHALIC INDEX

By combining my 1935 data with those of Herskovits the average cephalic index by age of the Negro can be shown for the whole life span from early infancy to adult age (table 1). Here the gradual decrease of the cephalic index is apparent.

The sexual differentiation of the index among Negroes is about the same as among Whites. For Negro adults there is an excess of the cephalic index in females as compared with males, amounting to .7. For white adults the difference is .6 in favor of the females (Boas, '10).

SECULAR CHANGES

In 1941 the author took head measurements on ninety-three Negro children between the ages of 4 and 7 whose diet since their infancy had been supervised by the Department of Health Clinics in Harlem, New York City. All of these children were born in New York City, and 47% of their parents had migrated to New York from the southern states. The parental composition as to the place of nativity is given for the entire series in table 2.

TABLE 1

Average cephalic index of Negroes by age.

AGE	MICHELSON 1935			HERSKOVITS 1923–1926			MICHELSON & HERSKOVITS COMBINED			EXCESS OVER SIGMA
	N	Mean	Sigma	N	Mean	Sigma	N	Mean	Sigma	
Male										
Days										
1– 89	13	80.7	....	....	....	....	13	80.7	....	....
90–179	62	84.2	±5.95	....	....	....	62	84.2	±5.95	....
180–269	38	84.3	±5.46	....	....	....	38	84.3	±5.46	....
270–359	33	83.5	±4.33	....	....	....	33	83.5	±4.33	....
Years										
1– 2	56	80.4	....	11	81.2	±4.11	67	80.53	....	....
2– 3	...	....	....	24	79.3	±3.22	24	79.30	±3.22	....
3– 4	...	....	....	31	78.5	±4.16	31	78.50	±4.16	....
4– 5	...	....	....	54	78.4	±4.22	54	78.40	±4.22	....
5– 6	39	79.42	±3.76	52	79.0	±3.69	91	79.18	±3.73	....
6– 7	41	78.55	±3.65	138	79.1	±3.98	179	78.97	±3.91	....
7– 8	25	76.94	±3.14	168	78.2	±3.60	193	78.04	±3.57	....
8– 9	19	79.29	±3.72	175	78.3	±3.86	194	78.40	±3.86	....
9–10	25	77.98	±3.96	166	78.2	±3.72	191	78.17	±3.75	....
10–11	29	77.05	±4.30	164	78.1	±3.58	193	77.9[illegible]	±3.72	....
11–12	28	77.15	±4.91	206	77.7	±3.37	234	77.63	±3.59	....
12–13	33	77.62	±4.13	232	77.9	±3.60	265	77.87	±3.67	....
13–14	38	78.08	±3.71	301	77.6	±3.42	339	77.65	±3.46	....
14–15	41	77.60	±3.32	257	78.1	±3.55	298	78.03	±3.52	....
15–16	28	75.39	±3.56	192	77.8	±3.12	220	77.49	±3.21	....
16–17	5	76.50	....	68	77.3	±3.27	73	77.25	....	....
17–18	2	77.00	....	47	76.9	±3.59	49	76.90	....	....
18 over	57	76.87	±2.59	1060	77.04	±3.44	1117	77.03	±3.40	....
Female										
Days										
1– 89	6	81.7	....	....	....	....	6	81.7	....	....
90–179	63	83.1	±5.13	....	....	....	63	83.1	±5.13	....
180–269	51	84.2	±5.66	....	....	....	51	84.2	±5.66	....
270–359	36	82.5	±4.14	....	....	....	36	82.5	±4.14	....
Years										
1– 2	65	81.4	....	5	80.5	....	70	81.34	....	+ .8
2– 3	...	....	....	19	77.9	±3.38	19	77.9	±3.38	−1.4
3– 4	...	....	....	36	80.0	±4.27	36	80.0	±4.27	+1.5
4– 5	...	....	....	23	78.3	±3.27	23	78.3	±3.27	− .1
5– 6	32	79.81	±4.07	62	78.7	±3.83	94	79.08	±3.95	− .1
6– 7	31	78.40	±4.23	78	78.55	±3.33	109	78.51	±3.61	− .5
7– 8	25	79.66	±4.84	96	78.9	±3.56	121	79.06	±3.87	+1.1
8– 9	21	77.78	±4.31	78	78.55	±3.95	99	78.39	±4.04	0
9–10	23	78.76	±3.18	55	77.4	±3.13	78	77.80	±3.16	− .4
10–11	23	77.94	±2.86	52	77.4	±3.49	75	77.57	±3.37	− .3
11–12	23	76.59	±3.06	52	77.35	±2.52	75	77.12	±2.72	− .5
12–13	21	77.65	±3.82	64	77.4	±3.01	85	77.46	±3.23	− .5
13–14	8	77.12	....	44	77.7	±3.27	52	77.61	....	− .1
14–15	15	78.37	....	50	77.3	±3.79	65	77.55	....	− .4
15–16	10	77.20	....	69	77.5	±3.13	79	77.46	....	0
16–17	8	77.87	....	104	77.4	±2.94	112	77.43	....	+ .1
17–18	3	77.17	....	125	77.6	±3.26	128	77.59	....	+ .7
18 over	409	77.51	±2.88	1260	77.73	±3.04	1669	77.68	3.00	+ .7

TABLE 2

Birthplace of parents producing series measured in 1941

Both parents born in North	13
One born in North, one in South	9
One born in North, one in West Indies or Virgin Islands	6
One born in North, one in Central or South America	1
Both parents born in South	38
One born in South, one in West Indies or Virgin Islands	2
One born in South, one in Central or South America	4
Both parents born in Central or South America	20
No. of children	93

TABLE 3

Average cephalic index by age of Negroes from New York on three different examinations.

AGE	HERSKOVITS-1923–26[1]			MICHELSON-1935			MICHELSON-1941		
	No.	Mean	Sigma	No.	Mean	Sigma	No.	Mean	Sigma
Male									
4 y.–4 y. 11 m.	54	78.4	± 4.2	..	...	..	20	81.4	± 5.1
5 y.–5 y. 11 m.	52	79.0	± 3.7	39	79.4	± 3.7	16	79.8	± 4 2
6 y.–6 y. 11 m.	138	79.1	± 4.0	41	78.6	± 3.6	9	81.0	± 2.7
Female									
4 y.–4 y. 11 m.	23	78.3	± 3.3	..	...	..	19	80.8	± 4.1
5 y.–5 y. 11 m.	62	78.7	± 3.8	32	79.8	± 4.0	17	79.9	± 2.8
6 y.–6 y. 11 m.	78	78.6	± 3.3	31	78.4	± 4.2	12	81.0	± 3.7

[1] From tables on pp. 113, 118 and 124.

Table 3 shows an increase in the average cephalic index for these children as compared with the measurements which Herskovits made in 1923 to 1926; and also as compared with measurements which the author made in 1935. The series of 1941 has, all in all, a smaller average length[2] and a greater average width of the head than was found in the unselected population prior to 1941.

On account of the small number of cases present in my 1941 series exaggerated conclusions should be avoided. I do not

[2] An irregularity will be found for the age group 5 years to 5 years eleven months, among males and females. However, this does not affect the general trend. My measurements are comparable with those of Herskovits since the same method was used by both.

venture more than to state that the particular group of children which was selected for a study of possible environmental influences on headform, show a tendency toward a plasticity of the head. So far, we know that they were provided with an optimal type of food; and beyond an assertion of this fact we cannot undertake any speculative interpretation of the phenomenon observed.

As a matter of fact, the significance of these findings becomes doubtful when tested by rigid statistical criteria. I have used as a test the standard error of the difference between two means, according to the formula:

$$\sigma D = \pm \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}} = \pm \sqrt{E^2_1 + E^2_2}, \qquad \text{in which}$$

σ_1 = standard deviation of first sample,
σ_2 = standard deviation of second sample,
N_1 = number of items in first sample,
N_2 = number of items in second sample;

and I have regarded the differences between the means as significant only when they exceed three times their respective errors.

To illustrate: $\pm \sqrt{\frac{4.2^2}{54} + \frac{5.1^2}{20}} = \pm 1.27$ and $78.4 - 81.4 = -3.$

The results of this test are given in table 4 and show that the difference between my series of 1941 and that of Herskovits is too small to be considered significant. Therefore, that which might be a change in the Negro's head form (as brought

TABLE 4

Standard error of difference and difference between the means of Herskovits ('23 to '26) and Michelson ('41) for the cephalic index.

AGE IN YEARS	STANDARD ERROR OF DIFFERENCE	DIFFERENCE BETWEEN MEANS
	Male	
4	± 1.27	— 3.0
5	± 1.05	— 0.8
6	± 0.96	— 1.9
	Female	
4	± 1.17	— 2.5
5	± 0.83	— 1.2
6	± 1.13	— 2.4

out by table 3) could be due to a factor of chance inherent in the series of 1941.

Evidently my material of 1941 is inadequate to decide whether any kind of change in the cephalic index of the Negro has taken place. My reasons for presenting these data in some detail, although they are not convincing, is to draw attention to the methodological aspect of the study.

THE CEPHALIC INDEX IN SIBLINGS OF DIFFERENT NATIVITY

I have investigated also whether environmental factors, as expressed by different birth places, exert an influence on the cephalic index of the American Negro. The problem was formulated as follows: Is the transplantation of the southern Negro to the North — for example, to New York City — accompanied by a change of the head form in the offspring born in the North?

This study, it will be recognized, is akin to those made by Boas and others on Hebrew immigrants. In 1909 and 1910 Boas ('10) found an average cephalic index of 83.0 for East European Hebrew immigrants and an average index of 81.4 for their American descendants. In 1935 I found an index of 78.7 for the descendants of American born East European Jews (Boas, '35). Recently, Dornfeldt ('41) has published a study on East European Jews and their descendants in Berlin, Germany, corroborating the findings of Boas in America.

The present study was carried out on a group of Negro children of the same parentage,[3] but some of the children born in the South and others in the North. The data on the cephalic index of these fraternities were corrected to adult, by fitting a straight line [4] to the averages of each age group. Only children over 4 years of age were used for comparison.

[3] Home visits to the respective families and frank talks with the parents enabled me to exclude children of different fathers.

[4] A straight line may mathematically be fitted to a series of values if they increase roughly at the same rate from year to year. This is done by the method of least squares, which consists of finding that straight line for which the sum of the squares of the deviations of all the values in the series is a minimum. The formula is in the form $y = ax + b$; and a and b are found by solving simultaneously the equasions $\Sigma fy = Na + b\Sigma fx$ and $\Sigma fxy = a\Sigma nx - b\Sigma fx^2$, where f is the number of cases at any one year, and N is the total.

The results are given in table 5 and show a slightly higher index in the case of the northern born males and the reverse in the case of southern born females. Thus the fraternities who were born after their parents had migrated from the South to the North fail to disclose any difference in the shape of the head. Though my series is small it indicates that the new environment did not affect the head form.

The question arises whether the socio-economic status of the migrated Negro was not a sufficiently potent factor to cause a change in headform. Although the American born descendant of the European immigrant grows up under a very

TABLE 5

Average cephalic indices (corrected to adult) of Negro children from same family, some born in North, others in South: Series of 1935.

GROUP	NO. OF CASES	CEPHALIC INDEX	SIGMA
	Males		
Northern born	30	76.77	± 4.18
Southern born	32	76.28	± 3.03
	Difference	+ .49 (S.E. ± 0.93)	
	Females		
Northern born	31	76.60	± 3.74
Southern born	38	76.66	± 2.85
	Difference	— .06 (S.E. ± 0.81	

much better environment than his parents, the migrated Negro is known to be in a less advantageous position. Does the stability of the poor socio-economic environment express itself in the stability of the head form?

We do not know which particular environmental factors are responsible for head plasticity. There are indications, however, that the tempo of growth is accelerated in any population that receives marked improvement in its housing and feeding. As far as the Negro is concerned, the environmental improvement may be insufficient in degree or not attainable up to those years when the cephalic index becomes almost stable, namely at about 4 years of age.

Perhaps only by comparing large numbers of Negro children who had the benefit of special care with those who did not can we discover whether we are dealing with an hereditary stability of the Negro's head form or with an artificial stability accounted for by a lack of fundamental improvement in environmental factors. The present study uses this approach, but because of inadequate samples, can be considered only a beginning.

SUMMARY AND CONCLUSIONS

1. The decrease of the cephalic index from birth to adult age is shown for the American Negro.

2. The excess of the female over the male Cephalic Index is about the same for Whites and Negroes.

3. For the general population of the American Negro the head form was found to be stable. Measurements made by the author in 1935 tallied with those obtained by M. J. Herskovits in 1923 to 1926.

4. A possible tendency toward a change in the head form could be detected in 1941 among a group of Negro children which had been on a scientific dietary regime since early infancy. This suggestive plasticity of the head represents a deviation from the dolichocephalic and mesocephalic toward the brachycephalic type. However, these findings were derived from a small series and the results are subject to an element of chance. A control study on a large scale is indicated.

LITERATURE CITED

BOAS, FRANZ 1910 Changes in bodily form of descendants of immigrants. State Doc. no. 208, 61st Congress, 2nd Session, Washington.

——— 1935 The tempo of growth of fraternities. Proc. Nat. Acad. Sci., vol. 21, no. 7, p. 418.

——— 1940 Age changes and secular changes in anthropometric measurements. Am. J. Phys. Anthrop., vol. 26, pp. 63–68.

DORNFELDT, WALTER 1941 Studien über Schädelform und Schädelveränderung von Berliner Ostjuden und ihren Kindern. Zeitschr. f. Morphol. u. Anthrop., vol. 39, pp. 290–372. (Reviewed in Zentralb. f. ges. Neurol. u. Psych., vol. 99, 1941, pp. 679–680.)

HERSKOVITS, MELVILLE J. 1930 The Anthropometry of the American Negro. New York.

REVIEWS

ALASKA DIARY. By Aleš Hrdlička. The Jaques Cattell Press, Lancaster, Pa. xv + 414 pp., frontispiece of the author and 234 figs., 1943. ($5.00.)

It is not often that a book comes to the reader printed from the original notes written in the field and unchanged by editing. Reading the Diary, this reviewer was vividly conscious of the Alaskan environment and of the spirit of the naturalist in the zealous explorer; the value of this sort of publication is of the order of the unretouched photograph.

The body of the book is made up of dated entries of the author's experiences during four exploratory visits to Alaska the summers of 1926, 1929, 1930 and 1931, "in quest of anthropological information" as stated in the preface. The first visit, recorded under the caption "Alaska", covered the Yukon, the western shores and islands, and served to initiate the explorer into the general conditions of the field besides yielding important anthropological data and materials. Detailed scientific exploration of the Yukon River was the work of the summer of 1929; of the Kuskokwim River on the third trip, 1930; and of southwestern Alaska, the Nushagak River and the Peninsula in 1931.

The notation of difficulties met with in the search for anthropological facts in this northern region is a conspicuous feature of the Diary, usually not in complaint but as incidents of the day. The season was short, hardly more than the month of June between freezing, stormy weather. Mosquitoes and gnats, rank vegetation and frozen ground were ever present annoyances and hindrances to the work of digging in old burial sites. Uncertainty of ways and means of travel, cold lodgings, and scarcity of food would have defeated a man of less courage and devotion to his objective. The author suffered severely from seasickness and from the loss of sleep caused by the howling of dogs to which the epithet "Yukon Chorus" was given. The stillness and solitude were at times depressing, "just vastness of nothing" as Hrdlička expresses it. The difficulties were more than compensated for by the valuable cooperation and cheering hospitality that were offered continuously during his visits. Gratitude and appreciation appear in the entries for the helpful response of individuals, the

Christian Missions, school teachers, the postmasters and cannery officials, and the officers of government boats — all having contributed to the success of the expeditions.

As one would assume, Dr. Hrdlička's search was in both fields, that of the living natives and of the remains, skeletal and artifacts, located at old village sites. At native communities full-bloods were sought, measured and photographed, making in the end an impressive collection. The Indians were found about the upper parts of the rivers, inland; Eskimo on the lower reaches of the great streams and along the coast. The entries confess difficulties, even in some instances impossibility of telling Eskimo from Indian. But typical Eskimos and Indians are in physiognomy and behavior quite distinguishable. Just as there are subtypes of Alaska Indians, so too the Eskimo are not homogeneous. "Evidently, they, as the Indians, came in a number of strains already from Asia". The author is impressed by the happy disposition of the Eskimo, his desire to cooperate, his industry, the good housekeeping traits of the women. He found them unspoiled by contact with the Whites (no profanity in their language), and predicts their making good citizens if wisely guided and protected against disease. Inquiry into birthplace of natives disclosed a sort of semi-nomadism prevalent. "Hardly ever encounter anyone from the locality where now present. And these are habits of old. A lesson for both anthropology and ethnography, and doubtless also for archaeology."

The chance of finding ancient burials is remote, for the river floods have washed away the sites along the banks and the tundra has assimilated the remains of those interred on higher ground. Much skeletal material of value was obtained, but not more ancient than a few hundred years at most. On the lower Kuskokwim the skeletons were "Quite homogeneous, and representing people just like those existing here." Interesting methods of sepulchring and coffining, the orientation and posture of the body are recorded. In contrast to the Indian's superstition respecting the dead, the Eskimo's attitude was indifferent: an old chief "Asks only, and that half-interestedly, if we have left his old wife there, in one of the fresh burials — would rather show us a grandmother." It is apparent in the entries that Dr. Hrdlička was exceedingly careful in the work of exhumation to get permission and to avoid in every possible way offending the natives. Many graves seen were marked by Russian crosses. The Russian Mission is now used as a church by the natives, and the Russian language lingers in some places.

Searches on the beaches and excavating in refuse heaps were rewarded with numerous artifacts in stone, slate and carved ivory. A fine fluted slate arrow point (Folsom?) was found on a beach of the

Nushagak, and four broken fluted points of green slate came out of an accumulation on a bluff at Pavik, both sites on the base of the Peninsula. The author indulging in reflections after the first trip, says: "What exists and can be traced now is all relatively recent to fresh. This is one of the strongest impressions of the journey."

The problem of the original Asiatic-American imigration was ever in the explorer's thoughts. He declares that the crossing to America itself is no problem: "in good weather could easily have been reached in even the smallest skin boats from Asia." And, "The whole trend of native movements to this day is from . . . Asia to America." Concludes that it could not have been a mass migration but that the "Asiatics came in dribbles." Lack of evidence of the presence of the early comers is explained by the destructive action of the elements in that cold, wet climate and especially by the migration of the great river valleys in a northern direction, washing away all traces of human occupation during the course of two or even one thousand years. The destruction is going on today.

Quite a number of the villages along the rivers were found to have been almost depopulated by the epidemic of influenza in 1919. Tuberculosis in several forms is prevalent and there is very little available to help the invalids. Dr. Hrdlička's coming was always known in advance of his arrival at a village and almost invariably he was met by sick people who begged to be examined and treated medically or surgically; and this service was given freely. In connection with this kind of missionary work, another sort was carried on, namely the giving of lectures and informal talks to the natives who sought his advice. Here was the opportunity to explain his work, to tell the Eskimo and Indian something of the history of their people, to give instruction in simple hygiene.

Throughout the Diary are many entries of observations and comments on the scenery, the animals and plants, the fine streams and the wild tundra. Outbursts of feeling such as the following occur frequently: "Glorious, glassy river again, high misty mountains as far down before us, others behind . . . a boundless beautiful primeval peace and solitude." On leaving the Paimute River (name means silence) Dr. Hrdlička writes: "Mute indeed in its human lonliness. But no river in Alaska, probably, fuller of beaver or geese in their season. Could it only be set aside as a sanctuary for these and other small people. It will never be fit for man — why not then leave it to living nature?"

The Diary concludes with a reference list of the author's publications on subjects concerned with the Alaska explorations.

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MAN'S UNKNOWN ANCESTORS: THE STORY OF PREHISTORIC MAN. By RAYMOND W. MURRAY. The Bruce Publishing Company, Milwaukee, xiv + 384 pp., including bibliography, glossary, and index. Ilus. 1943. ($3.50).

This book, by the head of the Department of Sociology at Notre Dame University, is an attempt to sketch the paleolithic and neolithic history of man in both the Old and New World. The volume is obviously intended as a beginning survey text for courses dealing with human evolution and prehistory. A concluding chapter, "Prehistory and Religion," seeks to explain the point of view of a cultivated Catholic scholar toward such problems as human evolution, pointing out that "prehistory and religion, properly understood, are not in conflict."

For college students of anthropology, Dr. Murray's book should prove stimulating. Lucidly written, it contains, in one volume, much material hitherto available only in separate works. Its faults are essentially those which the non-specialist must risk when drawing upon the works of authorities whose fields he does not know intimately and in detail. Even the specialist, venturing outside his particular discipline, is apt to be faced with this problem. It may represent no more than giving too great weight and space to certain workers and inadvertently ignoring others actually of more significance. It may mean that material not in the more accessible general treatises is overlooked. Or some particular author who has previously surveyed the field may be slavishly followed, in composing a particular section, so that the lay writer proceeds without ever realizing it at all, to repeat that man's prejudices, errors, and animosities.

Dr. Murray has fallen, here and there, into all these difficulties. In his survey of the Old World human remains, he fails to mention the Florisbad cranium, nor is the interestingly variant Steinheim skull adequately discussed in connection with the Swanscombe problem. As for the New World, Bird's work in Fell's Cave is referred to, though Bird's name is not mentioned. "Unfortunately," says Murray, "no human skeletal material was found there." Apparently he is unaware that though Fell's cave yielded no human remains, other sites in the same vicinity, Palli Aike and Serro Sota, did. In his treatment of the Moundbuilders, the outstanding contribution to the solution of their chronology made by Ford and Willey is similarly ignored. Though much attention is given to the work of the Colorado Museum of Natural History in relation to the discovery of early men in the Plains area, the numerous finds of the Nebraska State Museum are not mentioned.

All in all, while the book is reasonably accurate, and while it provides a useful rapid survey of vast areas of space and time, it is nevertheless in some degree superficial and lacking in that fine and discriminatory use of materials and command of the literature essential to the production of a really notable work.

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SOMATIC AND ENDOCRINE STUDIES OF PUBERAL AND ADOLESCENT BOYS. BY WILLIAM WALTER GREULICH, RALPH I. DORFMAN, HUBERT R. CATCHPOLE, CHARLES I. SOLOMON, AND CHARLES S. CULOTTA. Monographs of the Society for Research and Development, vol. 7, ser. no. 33, no. 3, 1943. 85 pages and 10 plates.

This is an interesting and well-presented study of certain somatic and endocrine changes associated with puberty and adolescence in boys. The report is divided into two distinct sections: I. Somatic Studies, and II. Endocrine Studies. The data were derived from studies on 757 white boys who ranged from 10 to 15 years of age at the time of the beginning of the observations. Most of the boys were re-examined at stated intervals over a period of 4 years. The group of boys under investigation consisted of "(A) 194 inmates of a state correctional institution for young boys; (B) 32 residents of a city orphanage; (C) 476 students of a large New England private school, most of whom were from families in the upper or upper-middle income group; (D) 55 boys, mostly from middle class urban families, living at home."

In the section devoted to somatic studies the emphasis was directed towards obtaining precise information concerning the nature and sequence of external bodily changes associated with sexual maturation. It begins with an excellent discussion of the external primary and secondary sexual characters in males and the order of their appearance and development. Particular attention is directed to the distribution and the nature of hair growth. This is followed by the presentation of a method of classifying puberal and adolescent boys into five categories or maturity groups representing "successive stages in the transition from the degree of physical immaturity which exists just before puberty to the degree of maturity which is usually associated with late adolescence". This classification may be regarded as a significant contribution and fulfills a need which has been long felt by researchers in the growth field. The photographic plates which illustrate the stages of the classification are very instructive in standardizing the categories for workers.

In the endocrine section, we find that analyses for androgens and estrogens were done by well-established biological tests. Eighty-two boys were studied, mostly from 10 to 17 years of age, but unfortunately there were not many repeated analyses on the same boys so that changes with age in the same individual cannot be ascertained by these data. The levels of urinary excretions are essentially in agreement with those previously reported, and it is clear from the data that the rate of excretion agrees more with the maturity status of the individual than with his chronological age. The authors point out quite correctly that similar observations ought to be made now with "a more comprehensive fractionation of the steroid metabolites "to try to ascertain the source of these substances in childhood, i.e., the adrenals or testes."

The determination of the urinary excretion rate of the gonadotropic hormones of the pituitary were also limited to boys. The method of assay employed the uterine weight of the immature mouse. Small amounts could be found before the twelfth year of life and between 13 and 14 years positive excretions of gonadotropic hormone were recorded in about half the cases studied though the amount was on the borderline of detectable amounts. Thereafter, the quantity of hormone definitely increased. They again found positive relationship between gonadotropic hormone excretion and maturity status, the amount increasing with the maturity of the individual more closely than with age. It appears clear that the pituitary has a gradual crescendo of activity in adolescence. This is analogous to the findings of other investigators.

The levels of these hormones in the blood would probably be of greater value, but they would give no index of rate of excretion. These urinary rates are interesting and help to explain the gradual development of puberty in the male. There are accumulating data from various laboratories which are establishing normal standards to which abnormal conditions of puberty may be compared. This is a profitable field of study for it places on a quantitative basis the activity of several glands which are obviously of great importance to normal growth and development.

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THE VERTEBRATE EYE AND ITS ADAPTIVE RADIATION. By Gordon Lynn Walls. Cranbrook Institute of Science, Bloomfield Hills, Michigan, Bull. no. 19, August 1942, xiv + 785 pp. ($4.00.)

THE RETINA. By S. L. Polyak. University of Chicago Press, Chicago, x + 607 pp. 1941. ($10.00.)

VERTEBRATE PHOTORECEPTORS. By Samuel R. Detwiler. The Macmillan Company, New York, xii + 184 pp. 1943. ($4.00.)

The evolution of visual functions in the primaries is a subject of considerable interest, and although a fair amount of work has been done in the field, it can scarcely be said that our knowledge of the evolution of the visual system is in any but a rather early stage of its development. The three volumes noticed here are to be welcomed as, each in its way, making a distinct contribution to our knowledge of the morphological basis of vision in the primates.

The first book, by an highly original investigator, Gordon Walls, interprets "comparative ocular biology as a whole to those who want to know what the eye is all about, but are repelled by the pedantic terminology of anatomy texts, the mathematics of physiological optics, the scatteredness of the ecological literature, and the German language." Walls is a sound and interesting interpreter, and his book represents a really remarkable feat of exposition. The field covered is enormous, and Walls seems to be at home in every part of it. He writes with unusual clarity, considerable charm, and not unwittily. Every aspect of vision is covered, and no one, whether he be layman or specialist can fail to derive an extraordinary amount of information concerning the nature of vision and the structure and functions of the organ which makes that complex experience possible.

In discussing color vision among the primates Walls suggests that trichromatic may have evolved independently in the platyrrhine and catarrhine monkeys, through, he tentatively suggests, achromatic (Aotus? marmosets?) and dichromatic (Cebus — and Callicebus?) stages in, at least, the platyrrhine series, "if not through equivalent (but missing) links on the catarrhine side." As a working hypothesis — and Walls puts it forward as even less than that, "a case of sorts . . ." — this is a very interesting suggestion, one which should be borne in mind by all workers in the field of primatology. Certainly, it fits the pattern of what is known of the general morphological relations existing between the two groups, many of which are very probably due to convergence.

In a footnote (p. 517) Walls notes that Aotus (sive Nyctipithecus) has a tapetum which is very different from that of the nocturnal lemuroids, and that this fact suggests that the nocturnality of Aotus is a secondary development. This is an excellent point in itself, and does not necessarily conflict with Wall's earlier suggestion. As Walls says, on an earlier page, it can be stated with practical certainty that

"any nocturnal member of an otherwise diurnal group has become nocturnal independently" (208). Aotus, the only nocturnal member of the Cebidae, is therefore certainly secondarily nocturnal. It is of interest to note that Aotus is also the only member of the Anthropoidea which has a tapetum (of the fibrous type), and whose eyeshine is said to be even more brilliant than that of the cat. Among the nocturnal prosimians the tapetum is of the cellular type, hence it is unlikely that the aotine tapetum is of prosimian origin.

I have dwelt thus briefly on this matter here in order to indicate the type of interesting leads, questions, and problems for research which this interesting book suggests. It is full of them. This is one among the many great merits of this outstanding book. The 200 illustrations and tables are unusually clear and helpful. I am acquainted with no book which so successfully conveys to the reader an understanding of the facts relating to the structure, function, and evolution of an organ as this. There is a good working bibliography and an excellent index. Dr. Walls is to be congratulated upon a book of which he may well be proud. The Cranbrook Institute of Science, at the press of which this book was printed, is to be felicitated upon its production, and for making this book — which originally started out to be a pamphlet — available in so accomplished a format and at a reasonable price.

Polyak's book makes a profound demand upon our stock of superlatives. Like Wall's it is an exemplary work, but whereas Wall's is a general work, Polyak's is a highly specialized one, and represents, for the most part, the report and interpretation of the author's original investigations correlated with what has previously been done this way. "It deals primarily with the minute structure of the human and simian retina as revealed by the Golgi technique." As such the work represents a very substantial contribution to our knowledge of the morphology of the retina and to an understanding of the whole visual process in relation to it.

The work is organized in five parts. In part 1 the material, methods, techniques, and procedures for the investigation of the retina and of the visual pathway are set out with clarity and in detail. In part 2 the author presents us with an historical survey of investigations of the faculty of vision, of the laws of optics, and of the structure of the eye, from classical antiquity to the Renaissance. In part 3 is set out the history of the investigations of the structure and function of the retina from the earliest times to the modern period. These two parts are accompanied by numerous illustrations, most of them here reproduced for the first time. These historical parts, occupying some 100 pages, represent an invaluable and original contribution to our under-

standing of the history of an hitherto obscure chapter in the history of science. These historical sections are not merely factual but critical and analytic. They serve to show not only what was previously done but also to increase the understanding and appreciation of Polyak's work. They constitute obligatory reading for all future workers in the field.

In part 4 Polyak gives a detailed and highly original account of the minute structure of the retina. As one reads this part one's admiration for the luminous manner with which the author handles his subject increases by leaps and bounds. Polyak has such a masterly grasp of his subject that he makes one feel that retinal morphology is really quite an easy subject to understand. In fact, he makes one feel that if all original investigators possessed his expository skill no subject would ever be difficult to understand. This is the book nonpareil on the anatomy, morphology, and neuro-physiology of the retina in the primates. Students of the evolution of the primates will find it indispensable.

In part 5 the structure of the retina is discussed in terms of the generally accepted theory of the minute organization of the nervous system, and the correlation of the concrete retinal structures to well-defined visual phenomena is attempted. This is by far the most interesting part of a most interesting book, and the one which is likely to have the widest range of readers. Here the various structures of the retina are correlated with the functions which Polyak considers there is good reason to believe they may perform. Polyak's discussion of this subject undoubtedly constitutes the most cogent and illuminating which exists in any language.

There are 100 excellent illustrations, a detailed bibliography of 129 pages, and an exhuastive index. Polyak's book constitutes a landmark in the history of the study of the eye. Its original contributions, and its attempts at correlation will greatly serve to advance the study of the eye as an organ.

Detwiler's book was written with the object of presenting "an account of the retinal photoreceptors in such a form as to be of value to those who have a general interest in the biology of the retina, rather than to the specialist." This object is very successfully achieved. The specialist, however, will find the book perhaps even more valuable than the non-specialist, in spite of the implied disclaimer. The reader wishing to obtain a straightforward up-to-date account of the character of the retina will find it in this book. Detwiler's book will be of especial interest and value to many readers of this journal because of the admirable presentation and discussion of his observations on the eyes of primates. A particularly important chapter is that which deals

with the evolution and significance of the fovea. Here Elliot Smith's and Woollard's conceptions of the macula and fovea and their evolutionary significance come in for well-founded criticism. Elliot Smith's view that a true macula cannot develop in the absence of uncrossed (temporal) fibers in the optic chiasm is shown, on the evidence of the conditions in many salt-water fishes and diurnal lacertilians, to be quite untenable. Elliot Smith's view that a wide range and a greater exactitude in conjugate movements is intimately associated with macular and foveal development, is shown to be rather more than questionable. Nor does Elliot Smith's notion that the macula is responsible for the larger brain of the marmoset as compared with that of the tarsier fare any better. Detwiler's obiter dictum that "neither the presence nor absence of a macula and fovea can be used to pigeonhole any animal in the evolutionary scale" is worth remembering.

The account of the significance of the fovea is based upon Wall's important investigations; from these it becomes highly probable that in man the fovea has somewhat degenerated, that the fovea is probably more developed in the anthropoids. If Wall's view is correct, and there is good reason to believe that it is, then, as Detwiler writes, "the concept of the fovea as a region devised to admit light unimpeded to the photoreceptors must be discarded, and this localized region of specialization must be viewed as a mechanism for increasing the resolving power of the retina" (p. 119).

The remainder of the book is devoted to a valuable and informative discussion of retinal photopigments, and vitamin-A deficiency and its effect upon the retina. There are 110 figures, most of which are based on the author's own work, there is a good bibliography, and an index.

There are one or two unimportant slips in Detwiler's text to which reference may be made here. Detwiler states that "double cones occur in all retinas except in mammals" (p. 42). This should read "placental or eutherian mammals," for double cones are present in the retinae of the prototherian monotremes and marsupials. The same correction should be made for Detwiler's statement with respect to "oil droplets" (p. 43), for these, too, occur in the prototheria.

Detwiler refers to Aotus as the "owl monkey." This name, first used by Bates of the Amazon, has long been discontinued; it is preferable to speak of "night monkeys."

Elliot Smith's name is spelled with one "t" and has no hyphen.

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NOTES

Prof. Dr. A. E. Bianchi of La Plata, Argentina, Prof. Dr. M. de Freitas Amorim of São Paulo, Brazil, and Prof. Dr. E. Herzog of Concepción, Chile, have founded the Revista Sudamericana de Morfología for the publication of original articles in anatomy, pathological anatomy, comparative anatomy, histology, anthropology and embryology. The first of the two parts of tomo I, under the general editorship of A. E. Bianchi, was scheduled to appear about the time this notice was going to press. Among the articles that will appear in the first volume are the following:

Henckel, K. O. and J. Dal Borgo — Some observations on the nasal skeleton.

Wenger, F. — The dimensions of the ilio-pelvic colon in Sucre (Bolivia).

Subscription rate for North Americans is $5.00. Communications should be sent to Prof. Dr. Bianchi at Córdoba 827, Buenos Aires, Argentina.

BIBLIOGRAPHY IN PHYSICAL ANTHROPOLOGY

JANUARY 1, 1942 TO JULY 1, 1943

This is the first of what we hope will be an annual series of Bibliographies to appear in the final number of each volume of this Journal. Henceforth the period covered will extend from mid-year to mid-year. In the preparation of this Bibliography I acknowledge gratefully the assistance of the following:

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The organization of the Bibliography and all proof-reading, both in typescript and in galley, have been my responsibility. If there are any errors — and I hope they are at a minimum — blame must rest with me.

It is our hope that colleagues in Physical Anthropology and in allied fields of human biology will find this Bibliography useful. To that end please look it over carefully and offer criticisms and comments freely, especially on organization and classification.

WILTON MARION KROGMAN
University of Chicago.

I. RACE

General References

BEAGLEHOLE, ERNEST 1943 Race, caste and class. J. Polynesian Soc., 42: 1–11.

BENEDICT, RUTH, AND MILDRED ELLIS 1942 Race and cultural relations: America's answer to the myth of a Master Race. Nat. Educ. Assoc. of U. S., Washington.

BOAS, FRANZ 1943 Class consciousness and race prejudice. Christian Register for Jan.

——— 1943 Individual, family, population and race. Proc. Am. Philos. Soc. 87: 161–164.

BOLETIN BIBLIOGRAFICO DE ANTROPOLOGIA AMERICANA. Vol. V., nos. 1, 2 y 3. — 404 pags. Editado por el Instituto Panamericano de Geografia e Historia. — Mexico, 1942.

CASTLE, W. E. 1942 Dog crosses and human crosses. J. Hered. 33: 249–252.

CHAPPLE, E. D., AND CARLETON STEVENS COON 1942 Principles of Anthropology. New York (Henry Holt & Co.).

DAHLBERG, G. 1942 An analysis of the conception of race and a new method of distinguishing races. Hum. Biol. 14 (3): 372–385.

——— 1942 Race, reason and rubbish., (trans. by L. Hogben). N. Y., (Columbia U. Press).

DENNIS, W. 1942 The significance of feral man. Am. J. Psychol. 54: 425–432. (Biol. Abst. Sec. A 16 (7) 1942).

DUDLEY, F. C., AND W. ALLAN 1942 Mating customs in N. Carolina, 1750–1900. J. Hered. 33 (9): 331–332 (comment by R. Cook and S. Wright on pp. 332–334).

FARNSWORTH, D. W. 1942 Radiation pattern of the human voice. Sci. Mo. 55: 139–143.

FORD, C. S. 1942 Culture and human behavior. Sci. Mo. 55 (6): 546–557.

GOLDSCHMIDT, RICHARD 1942 Anthropological determination of ''Aryanism''. J. Hered. 33: 215–216.

GIRÓN, L. GUSTAVO 1942 Anatomía y Antropología. Actas de la I Sesión del XXVII Congr. Intern. de Amer. (Mexico, 1939), I: 186–188.

GRAUBARD, M. 1942 Food habits of primitive man. Sci. Mo. 55 (4): 342–349; 55 (5): 453–460.

HALDANE, J. B. S. 1942 New paths in genetics. New York and London (Harper and Bros.).

HART, C. W. M. 1942 The race myth. U. Toronto Quar. 11: 180–188.

LAIDLER, H. W. 1942 The role of the races in our future civilization. New York (League for Industrial Democracy).

LITTLE, K. L. 1942 Race relations in English society. Preliminary report on a community survey. Man, 42: 90–91.

——— 1943 A note on colour prejudice among the English ''Middle Class''. Man, 43: 104–107.

MALZBERG, B. 1943 Race differences in intelligence. J. Hered. 34 (6): 174 and 192.

MAYR, ERNST 1942 Systematics and the origin of species. New York (Columbia U. Press).
MONTAGU, M. F. ASHLEY 1942 Man's most dangerous myth: The fallacy of race. With a foreword by Aldous Huxley. New York (Columbia U. Press).
POSADA, JUAN DE LA CRUZ 1942 Geografía humana. Bol. Soc. Geogr. Colombia 7 (2): 182–186. (Biol. Abst. Sec. A 17 (6) 1943).
PRICE, W. A. 1942 Race betterment through preventive dentistry. J. Am. Dent. Assoc. 29: 213–221.
ROMERO, JAVIER 1942 Técnica antropológica de exploración. Actas de la I Sesión del XXVII Congr. Intern. de Amer. (Mexico, 1939), I: 156–177.
RUBIN DE LA BORBOLLA, D. F. 1942 Problemas de metodología en la antropología fisica. Actas de la I Sesión del XXVII Congr. Intern. de Amer. (Mexico, 1939), 1, 151–155.
SCHIFF, FRITZ, AND WILLIAM C. BOYD 1942 Blood grouping technic. New York (Interscience Publishers).
STEWART, T. D. 1942 A selective guide to the material published in 1941 on anthropology; Middle and South America: physical anthropology. Handbook Latin Am. Studies, no. 7, 75–78.
STRANDSKOV, H. H. 1942 The genetics of human populations. Am. Nat. 77: 156–164.
WHITE, J. S. 1943 Taine on race and genius. Soc. Res. 10: 76–99.

The Americas: White and Indian

ANONYMOUS 1942 Is America's population increasing? Statist. Bull. Metropolitan Life Ins. Co. 23 (2): 3–5. (Biol. Abst. Sec. A 17 (1) 1943).
ALBERTO, ARCA PARRÓ 1942 Census of Peru, 1940. Geogr. Rev. 32 (1): 1–20.
BARRIENTOS, R., JUVENAL 1943 (?) Antropología constitucional de 116 Araucanos actuales de Temuco y sus alrededores. Rev. Mus. Hist. Nac. Chile, año 1, no. 3, pp. 270–418. Not dated).
CANAS, L. B., M. SALAZAR, Y P. LUROS 1942 Promedio de las medidas externas de la pelvis de la mujer Costarricense. Rev. Med. (San José) 5 (94): 127–129. (Biol. Abst. Sec. A 17 (3) 1943).
COMAS, JUAN 1942 El problema de la existencia de un tipo racial Olmeca. Mayas y Olmecas. Segunda Reunion de Mesa Redonda sobre problemas antropologicos de Mexico y Centro America, 69–70.
——— 1942 La sistematica racial en México. El México Antiguo, VI: 1–3.
CONSTANZÓ, M. DE LAS M. 1942 Antropología calchaquí la collección Zavaleta del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia." Rev. Inst. Antrop. Univ. Nac. Tucumán 2 (9): 213–308. (Am. J. Phys. Anthrop., n. s. 1 (1): 120–122 1943).
——— 1942 Datos sobre la antropología físicia de los antiguos habitantes de Cuyo. An. Inst. Etnogr. Am. Univ. Nac. Cuyo 3: 323–338. (Am. J. Phys. Anthrop., n.s. 1 (1): 120–122 1943).
COOK, S. F. 1942 The population of Mexico, in 1793 Hum. Biol. 14 (4): 499–515.
D'ALOJA, ADA 1942 Sobre la variabilidad de algunos caracteres antropométricos observados en grupos indigenas centro-americanos. Actas de la I Sesión del XXVII Congr. Intern. de Amer. (Mexico, 1939), I: 178–185.

Girard, Rafael 1942 Caracteres antropométricos de los Chortis. An. Soc. Geogr. e Hist. de Guatemala, tomo 17, no. 6; pp. 412–423.

Goldstein, M. S. 1943 Observations on Mexican crania. Am. J. Phys. Anthrop., n.s. 1 (1): 86–94.

Gómez Robleda, José 1943 Pescadores y Campesinos Tarascos. Ediciones de la Secretaria de Educacion Publica., Mexico.

Helm, J. D., and M. H. Jacobs 1943 Some apparent differences between the erythrocytes of White and Negro subjects. J. Cell. and Comp. Physiol., 22: 43–50.

Hrdlička, A. 1942 Catalogue of crania in the United States National Museum collections: Eskimo in general. Proc. U. S. Nat. Mus., 91: 169–429.

Jaffe, A. J., and W. I. Lourie 1942 An abridged life table of the white population of the U. S. in 1830. Hum. Biol. 14 (3): 352–371 (Biol. Abst. Sec. A 17 (4), 1943).

Kiser, C. V. 1943 Group differences in urban fertility. Baltimore, (Williams & Wilkins) (Science 97 (2512): 185–186, 1943).

Kroeber, A. L. 1942 Cultural and natural areas of native North America. U. Calif. Publ. Am. Arch, Ethnol., 38: 1–242.

Neumann, Georg 1942 American Indian crania with low vaults. Hum. Biol. 14 (2): 178–191. (Biol. Abst. Sec. A 17 (4) 1943).

Roquete Pinto, Edgard 1942 Contributions to the anthropology of Brazil. Proc. VIII Am. Sci. Congr., 2: 241–243.

Pijoan, Michel, C. A. Elkin, and C. O. Eslinger 1943 Ascorbic acid deficiency among Papago Indians. J. Nutr., 25 (5): 491–496.

Santiana, Antonio 1942 Contribuciones al estudio de la antropología ecuatoriana. La dentadura de los Indios de Imbabura y Chimborazo. An. Univ. Central del Ecuador, 575–641.

Smith, Mapheus, and R. B. Moton 1942 Jewish production of American leaders. Sci. Mo. 55: 144–150.

Steggerda, Morris 1943 Stature of South American Indians. Am. J. Phys. Anthrop., n.s., 1 (1): 5–20.

Stewart, T. D. 1943 Distribution of cranial height in South America. Am. J. Phys. Anthrop., n. s., 1 (2): 143–156.

The Americas: Negro

Amaral, R. D. 1942 Vital deficit (discrepancy between birth and death rates) of Negro in São Paulo. Publ. med., São Paulo, 13: 75–80.

Brent, M. J. 1943 Report of Sub-Committee on birth control of National Medical Association. J. Nat. Med. Assoc., 35: 25–27.

Charles, C. V. 1942 Optimism and frustration in American Negro (analysis of Richard Wright's "Native Son"). Psychoanalyt. Rev. 29: 270–299.

Cobb, W. M. 1942 Physical anthropology of the American Negro. Am. J. Phys. Anthrop 29 (2): 113–223. (Biol. Abst. Sec. B 16 (10) 1942).

——— 1942 Physical anthropology and the Negro in the present crisis. J. Nat. Med. Assoc. 34: 181–187.

Ferebee, D. B. 1942 Planned parenthood as public health measure for Negro race. Human Fertil., 7: 7–10.

Hrdlička, A. 1942 The scapula: visual observations. Am. J. Phys. Anthrop., 29: 73–94.

Little, G. 1942 Analytic reflections on mixed marriages. Psychoanalyt. Rev., 29: 25–25.

McWilliams, Carey 1943 Brothers under the skin. Boston, (Little, Brown).

Michelson, Nicholas 1943 Investigations in the physical development of Negroes: I. Stature. Am. J. Phys. Anthrop., n. s., 1 (2): 191–214.

Overton, J., and I. Uffelman 1942 Birth control service among urban Negroes: study conducted by Department of Health, City of Nashville. Human Fertil., 7: 97–101.

Pierson, D. 1942 Negroes in Brazil: a study of race contact at Bahia. Chicago, (U. of Chicago Press).

Simmons, K. 1943 Cranial capacities by both plastic and water techniques with cranial linear measurements of the Reserve collections, White and Negro. Human Biol., 14: 473–498.

Snitow, Virginia L. 1942 I teach Negro girls. New Republ. 107: 603–605.

Sousa, O. Machado de 1942 Accessory obturator nerve in Brazilian Whites and Negroes. Folia clin. et biol., 14: 33–44.

Steggerda, M. and T. J. Hill 1942 Eruption time of teeth among Whites, Negroes and Indians. Am. J. Orthod., 28: 361–370.

Terry, R. J. 1942 Absence of the superior gemellus muscle in American Whites and Negroes. Am. J. Phys. Anthrop., 29: 47–56.

———— 1943 The inclination of the saddle surface of the trapezium with respect to the angle between the thumb and wrist. Am. J. Phys. Anthrop., n. s., 1: 157–169.

Europe and Africa

Coon, C. S. 1942 "Have the Jews a racial identity?" in Jews in a Gentile World (ed. I. Graeber and Stewart H. Britt). New York (Macmillan Co.).

Ellinger, Tage J. H. 1942 On the breeding of Aryans. J. Hered., 33: 141–143.

Hrdlička, A. 1942 An anthropologist in Russia. I, II, III. Sci. Mo. 54 (3): 269–276; 54 (4): 308–19; 54 (5): 397–417.

———— An anthropologist in modern Russia. Sci Mo. 55 (1): 19–28.

———— 1942 The peoples of the Soviet Union. Smithsonian Inst. War Background Studies no. 3, Washington.

Kirk, Dudley 1942 The relation of employment levels to births in Germany. Milbank Mem. Fund Quart. 20 (2): 126–138. (Biol. Abst. Sec. A 17 (3) 1943).

Maung, K. 1942 Measurement of association in contingency table with special reference to pigmentation of hair and eye colors of Scottish school children. Ann. Eug., vol. 11, pp. 189–223.

Montagu, M. F. Ashley 1943 On the breeding of Aryans. Psychiatry, 6: 254–255.

Peel, R. F. 1942 The Tibu peoples and the Libyan Desert. Georg. Jour., 100 (2): 73–87. (Biol. Abst. Sec. A 17 (2) 1943).

Asia and Oceania

ANONYMOUS 1942 Australia and America — a parallel. Statist. Bull. Metropolitan Life Ins. Co. 23 (4): 4–6. (Biol. Abst. Sec. A 17 (1) 1943).

BISHOP, C. W. 1942 Origin of the Far Eastern civilizations. Smithson. Inst. War Background Studies no. 1. Washington.

HRDLIČKA, ALEŠ 1942 Crania of Siberia Am. J. Phys. Anthrop., 29 (4): 435–482.

KENNEDY, R. 1943 Islands and peoples of the Indies. Smithsonian Inst. War Background Studies no. 14, Washington.

KRIEGER, H. W. 1942 Peoples of Philippines. Smithsonian Inst. War Background Studies no. 4, Washington.

MCCLEARY, G. F. 1942 Australia's population problem. Milbank Mem. Fund Quart. 20 (1): 23–34. (Biol. Abst. Sec. A 16 (8) 1942).

Racial Physiology and Pathology

ALTSCHUL, A., AND A. NATHAN 1942 Diabetes mellitus in Harlem Hospital Outpatient Dept. in New York; comparison of certain etiologic factors in Negro and white patients. J. Am. Med. Assoc. 119: 248–252.

ANONYMOUS 1942 The changing aspect of tuberculosis mortality 1920 to 1940. Statist. Bull. Metropolitan Life Ins. Co. 23 (3): 5–9. (Biol. Abst. Sec. A 17 (1) 1943).

BAKER, P. P. 1943 Results and observations on insulin shock therapy in Negro ex-service men. J. Nat. Med. Assoc. 35: 16–24.

BLUMENTHAL, F. 1942 Racial differences in resistance to respiratory infection. Hum. Biol. 14 (1): 104–109.

BRADFORD, W. B. & W. Z. BRADFORD 1942 Comparative study of pregnancy in white and colored races. North Carolina Med. J. 3: 172–175.

BRUNO, F. E. AND H. T. ENGELHARDT 1942 Clinicopathologic study of rheumatic fever and rheumatic heart disease in white and Negro races. New Orleans M. & E. S. J. 95: 234–238.

BYRD, T. L. Diabetes mellitus. J. Med. Assoc. Georgia. 31: 238–242.

CALLAN, R. Polydactyly in Negro family. J. Hered. 33: 229–232.

COHEN, A. 1941 Gout and the Negro. South Med. & Surg. 103: 654–655.

CONNOLLY, C. J. 1942 The fissural pattern in the brain of Negroes and Whites (continued). The parietal and temporal lobes. Am. J. Phys. Anthrop. 29: 225–266.

CULLEN, V. F., AND R. HOFFMAN 1942 Tuberculosis. Am. Rev. Tuberc. 45: 53–60.

DERBES, V. J., AND H. T. ENGLEHARDT 1943 Incidence of bronchial asthma in the White and Negro. Am. J. Med. Sci. 205: 675–677.

ENGELHARDT, H. T. AND F. E. BRUNO 1942 Clinicopathologic study of diabetes mellitus in the South. New Orleans M. & S. J. 95: 137–140.

GARVIN, C. F. 1942 Age, sex and race relationships of auricular fibrillation. Am. J. Med. Sci. 203: 788–792.

GRIECO, J. 1942 Tuberculosis in city of São Paulo. Rev. Paulista de tisiol 8; 211–266.

VON HENTIG, HANS 1942 The criminality of the colored woman. Univ. of Col. Studies, Ser. C., Studies in Social Science, 1: 231–261.

HOAGLAND, H. 1943 The chemistry of time. Sci. Mo. 56: 56–61.

IRGANG, S. 1942 Dermatomyositis: clinical and histologic study of skin of 2 cases. Urol. & Cutan. Rev. 46: 251–257.

JONES, E. C. 1942 Incidence of pinworm infection in white and Negro hospitalized children. Am. J. Dis. Child. 64: 803–806.

KAHN, F. 1943 Man in structure and function (trans. by Geo. Rosen), New York, (Knopf).

KENNEDY, C. B., J. K. HOWLES, V. M. HENNINGTON, AND M. E. KOPFLER 1942 Cutaneous tuberculosis and related diseases in southern Negro. South. Med. J. 35: 449–456.

KILB, L. C. 1942 Multiple sclerosis in American Negro. Arch Neurol. & Psychiat. 47: 413–421.

LEWIS, JULIAN H. 1942 The biology of the Negro. Chicago (U. of Chicago Press).

LEWIS, R. C., A. ILIFF, AND A. M. DUVAL 1943 Further considerations of the effect of altitude on basal metabolism. A study on young women residents of Denver. J. Nutrition 26: 175–185.

LEWIS, R. C., A. ILIFF, A. M. DUVAL AND G. M. KINSMAN 1943 The effect of change of altitude on the blood of human subjects. J. Lab. Clin. Med. 28: 860–866.

——— 1943 The effect of change of altitude on the basal metabolism of human subjects. J. Lab. Clin. Med. 28: 851–859.

LISA, J. R., C. SOLOMON AND E. J. GORDON 1942 Addison's disease; report of 3 cases and review of literature. New York State J. Med. 42: 1940–1943.

LOVELESS, J. A., AND W. DENTON 1943 Oral use of sulfathiozole (sulfonamide) as prophylaxis for gonorrhea (and chancroid). Preliminary report. J. Am. Med. Assoc. 121: 827–828.

MACFARLANE, E. W. 1942 Blood group reactions in cord bloods of Indians of Calcutta. Am. J. Clin. Path. 13 (2): 81–86.

MARVIN, H. P. AND E. R. SMITH 1942 Hypertensive cardiovascular disease in Panamanians and West Indians residing in Panama and Canal Zone. Mil. Surgeon 91: 529–535.

PAYNE, H. M. 1942 Incidence of tuberculosis in Negroes of college age. Journal-Lancet 62: 400–402.

PETERSON, W. F., AND ALVIN MAYNE Cytoplasmic modification of genetic trends. J. Am. Med. Assoc. 121: 929–931.

PIPKIN, A. C., AND S. B. PIPKIN 1942 Albinism. J. Hered. 33: 419–427.

PRUDHOMME, C. 1942 Dilantin sodium (phenytoin sodium) in treatment of epileptic Negroes. J. Nat. Med. Assoc., 34: 150–153.

PUFFER, R. R., R. S. GASS, W. J. MURPHY, AND W. C. WILLIAMS 1942 Tuberculosis studies in Tennessee; morbidity and mortality in colored families during period of observation. Am. J. Hyg. 35: 367–376.

QUINLAND, W. S. 1942 Bronchogenic carcinoma; 3 cases. South Med. J. 35: 729–732.

ROBINS, A. B. 1943 Development of tuberculosis in apparently healthy adult (incidence in white & Negro population as determined by roentgenography). Am. Rev. Tuberc. 47: 1–10.

Rostenberg, A., Jr., and N. M. Kanof 1942 Eczematous sensitizations; comparison between sensitizing capacities of 2 allergens and between 2 different strengths of same allergen and effect of repeating sensitizing dose; comparisons between Negro and White. J. Invest. Dermat. 4: 505–516.

Saunders, G. M., and H. Bancroft 1942 Blood pressure studies on Negro and white men and women living in the Virgin Island of the United States. Am. Heart J. 23: 410–423.

Sayer, A. 1943 Psoriasis in full-blooded Negro: case. Arch. Dermat. & Syph. 47: 102–104.

Scott, R. B., and P. T. Johnson 1942 Laurence-Moon-Biedl syndrome; occurrence in Negro child; treatment with gonadotropin and androgen. Am. J. Dis. Child. 63: 733–741.

Seltzer, C. C. 1943 Anthropometry and arthritis: I & II. Differences between rheumatoid and degenerative joint disease in males and females. Medicine 22 (2): 163–188; 189–203.

Silveira, J. and E. Da Costa 1942 Tuberculin reaction in Negroes of Bahia. Bahia Med. 12: 59–62.

Snell, A. C., Jr. 1942 Laurence-Moon-Biedl syndrome; case in Negro family. Arch. Ophth. 28: 12–16.

Thomas, C. C. 1942 Sarcoidosis (12 cases). Arch. Dermat. & Syph. 47: 58–73.

Turner, E. L., M. J. Bent, G. D. Holloway and J. R. Cuff 1942 Icterus complicating lobar pneumonia in Negro patient; experimental production of icterus-confirmation of Maugeri's experiments. J. Nat. Med. Assoc. 34: 47–52.

Walker, H. H. 1942 Public health birth control center. Human Fertil. 7: 27–28.

West, H. D. and N. C. Jefferson 1942 Blood serum calcium in Negroes with tuberculosis. Am. Rev. Tuberc. 45: 346–348.

Body-Build and physical status

Barrientos, R., Juvenal 1943 Consideraciones generales sobre antropología constitucional. Rev. Mus. Hist. Nac. Chile, año 1, no. 3, pp. 217–235.

Betz, B. J. 1942 Somatology of the schizophrenic patient. Hum. Biol. 14 (1): 21–47; 14 (2): 192–234.

Bowlby, John 1942 Personality and mental illness. An essay in psychiatric diagnosis. New York (Emerson Books).

Brouha, L. 1943 The step test: a simple method of measuring physical fitness for muscular work in young men. Res. Quar. Am. Assoc. Health. Phys. Ed. Recreation 14 (1): 31–36.

Brouha, L. and C. W. Heath 1943 Resting pulse and blood pressure values in relation to physical fitness in young men. New England J. Med. 228 (15): 423–426.

Ciocco, Antonio 1943 Birth order and heart rate in children. Hum. Biol. 15 (2): 171–174.

Damon, A. 1942 A note on the estimation of dysplasia in human physique: Sheldon's method and the analysis of variance. Hum. Biol. 14 (1): 110–112.

DONELSON, E. G., J. M. LEICHSENRING, AND M. A. OHLSON 1943 Variability of certain factors in the blood picture of women. Am. J. Physiol. 138 (4): 626–629.

FRANSEEN, E. B., AND F. A. HILLEBRANDT 1943 Postural changes in respiration. Am. J. Physiol. 138 (2): 364–369.

GALLAGHER, J. R. AND L. BROUHA 1943 A simple method of testing the physical fitness of boys. Res. Quar. Am. Assoc. Health. Phys. Ed. Recreation. 14 (1): 23–30.

——— 1943 A simple method of evaluating fitness in boys: the step test. Yale J. Biol. Med. 15 (6): 769–779.

——— 1943 Dynamic physical fitness in adolescence. Yale J. Biol. Med. 15 (5): 657–670.

——— 1943 The evaluation of athletic programs by means of fitness tests. Yale J. Biol. Med. 15 (5): 671–677.

GALLAGHER, J. R., C. D. GALLAGHER, AND L. BROUHA 1943 A practical bicycle ergometer test of fitness for adolescents. Yale J. Biol. Med. 15 (5): 679–688.

——— The evaluation of a "body-building" program utilizing a bicycle ergometer test. Yale J. Biol. Med. 15 (5): 689–692.

HILLEBRANDT, F. A., AND E. B. FRANSEEN 1943 Physiological study of the vertical stance of man. Physiol. Rev. 23 (3): 220–254.

JOHNSON, T. J., L. BROUHA, AND J. R. GALLAGHER 1943 The use of the step test in the evaluation of the fitness of adolescents. Yale J. Biol. Med. 15 (6): 781–785.

ROE, ANNE, AND DAVID SHAKOW 1942 Intelligence in mental disorder. Ann. New York Acad. Sci. 42 (4): 361–490. (Biol. Abst. Sec. A 16 (10) 1942).

SHELDON, W. H. (With the collaboration of S. S. Stevens) 1942 The varieties of temperament. New York (Harper and Brothers). (Biol. Abst. Sec. A 16 (8) 1942.)

SHOCK, N. W. 1943 The effect of menarche on basal physiological function in girls. Am. J. Physiol. 139 (2): 288–292.

SELTZER, C. C., AND L. BROUHA 1943 The "masculine" component and physical fitness. Am. J. Phys. Anthrop. n. s., 1 (1): 95–108.

SELTZER, C. C. 1943 The value of the shoulder-hip ratio as an index of masculinity and its relation to dynamic physical fitness. Rev. Canad. de Biol. 2 (3): 329–331.

TAFT, D. R. 1942 Criminology. An attempt at a synthetic interpretation with a cultural emphasis. New York (Macmillan Co.).

TUTTLE, W. W. 1943 The effect of weight loss by dehydration and the withholding of food on the physiological responses of wrestlers. Res. Quar. Am. Assoc. Health. Phys. Ed. Recreation. 14 (2): 155–166.

YOUNG, C. M., M. S. PITTMAN, E. G. DONELSON AND G. M. KINSMAN 1943 The effect of the selection of data on the mean basal metabolism and the variability of the basal metabolism of a large series of college women. Am. J. Physiol. 139 (2): 280–287.

WOLFF, G. AND M. STEGGERDA 1943 Female-male index of body build in Negroes and Whites; an interpretation of anatomical sex differences. Hum. Biol. 15: 127–152.

II. PREHISTORY

General References

ANONYMOUS 1942 The Bones of Men and Apes. Science 95 (2470): 10 (Suppl.).

CHILDE, V. G. 1942 What happened in history. London and New York (Harmondsworth & Penguin Books).

DE PROROK, BYRON 1942 Dead men do tell tales. New York (Creative Age Press, Inc.)

HAWKES, C. F. C. 1942 Race, prehistory & European civilization. (Contribution to a symposium on "The Scientific Attitude to Fascism, with special reference to Race Theories" given April 6, 1942). Man (Nov.–Dec.) 125–130.

HENCKEN, H. O'NEILL 1943 Archaeological evidence of invasion. Am. J. Archaeol. 47 (1): 88–90.

HOWELLS, W. W. 1942 The age of Homo sapiens. Sci. Mo. 54 (6): 552–556. (Biol. Abst. Sec. B. 16 (10) 1942).

——— 1942 Fossil man and the origin of races. Am. Anthrop. 44 (2): 182–193. (Biol. Abst. Sec. A 17 (5) 1943).

MCATEE, W. L. 1942 The cause of domestication. Science 96 (2488): 231.

MONTAGU, M. F. ASHLEY 1942 On the origin of the domestication of the dog. Science 96 (2483): 111–112.

WEIDENREICH, FRANZ 1943 The "Neanderthal man" and the ancestors of "Homo sapiens." Am. Anthrop. 45: 39–48. (Biol. Abst. Sec. A 17 (6) 1943).

WILSON, J. A. 1942 Archaeology as a tool in humanistic and social studies. J. Near East Studies 1 (1): Jan.

North America

ANDERSON, EDGAR, AND F. D. BLANCHARD 1942 Prehistoric maize from Cañon del Muerto. Am. J. Bot. 29 (10) 832–835. (Biol. Abst. Sec. A 17 (5) 1943).

ANONYMOUS 1942 Discovery of Yuma points. Science 96 (2494): 12 (Suppl.).

——— 1942 Early Man in New Mexico. Nature 149 (3773): 222.

——— 1942 Recent advances in American archaeology. Nature 150 (3796): 155–158.

——— 1942 The earliest account of the association of human artifacts with fossil mammals in N. America. Science 95 (2467): 380–381.

BAILEY, A. G. 1942 The Indian problem in early Canada. American Indigena, 2: 35–39.

CARTER, T. C. 1942 A preliminary report on the Ellis Co. skull. Proc. Oklahoma Acad. Sci. 22: 24–26. (Biol. Abst. Sec. A 17 (1) 1943).

EISELEY, L. C. 1942 The Folsom mystery: its solution is contingent on the solution of another mystery. Sci. Amer. 167: 260–267. (Biol. Abst. Sec. A 17 (5) 1943).

HAAG, W. G. 1942 Early horizons in the Southeast. Am. Antiq. 7 (3): 209–222.

HEWES, G. W. 1943 Camel, horse and bison associated with human burials and artifacts near Fresno, Calif. Science, 97 (2519): 328–329.

HURT, W. R. 1942 Folsom and Yuma points from the Estancia Valley, N. M. Am. Antiq. 7 (4): 400–402.

JOHNSON, FREDERICK, et al. 1942 The Boylston St. fishweir. A study of the archaeology, biology, and geology of a site on Boylston St. in the Back Bay Dist. of Boston, Mass. Papers Peabody Mus. Harvard Univ. 2: xii + 212 pp. (Biol. Abst. Sec. A 17 (5) 1943).

KNIPE, D. A. 1942 A date from Chaco Yuma West, Southern Arizona. Tree-Ring Bull. 8 (3): 24. (Biol. Abst. Sec. A 17 (2): 1943.).

MARTIN, P. A. 1942 Recent Mogollon discoveries. Sci. Mo. 54: 385–389.

MARTIN, P. S. 1943 The Su site; excavations at a Mogollon Village, Western New Mex., Sec. Season, 1941. Field Mus. Nat. Hist., Anthrop. Series 32, no. 2.

MCGREGOR, J. C. 1942 Dates from Kinnkinnick Pueblo. Tree-Ring Bull. 8 (3): 21–23. (Biol. Abst. Sec. A 17 (2) 1943).

MILLER, J. L. 1942 Dates from Fort Grant Pueblo, Southern Arizona. Tree-Ring Bull. 8 (3): 24. (Biol. Abst. Sec. A 17 (2) 1943).

MORANT, G. M. 1943 Eskimo craniology. Nature 151 (3819): 59–60.

MORLEY, S. G. AND OTHERS 1943 Recent advances in American Archaelogy. Proc. Am. Philos. Soc. 86 (2) (Papers by: Morley, Collins, Cressman, Hibben, Howard, Haury, Colton, McGregor, Cole, Lewis, Ritchie, Cross, Valliant, Bennett).

NEUMANN, G. K. 1942 American Indian crania with low vaults. Hum. Biol. 14 (2): 178–191.

——— 1942 Types of artificial cranial deformation in the Eastern United States. Am. Antiq. 7 (3): 306–310.

NEWMAN, M. T., AND C. E. SNOW 1942 Preliminary report on the skeletal material from Pickwick Basin, Ala. Bull. Bu. Am. Ethnol., no. 129, pp. 395–507. (Am. J. Phys. Anthrop. 29 (3): 433, 1942).

QUIMBY, GEORGE 1942 The Natchezan culture type. Am. Antiq. 7 (3): 255–275.

ROBERTS, F. H. 1942 Archaeological and geological investigations in the San Jon District, Eastern N. M. Smithsonian Misc. Coll. 103 (4).

SCHULTZ, C. BERTRAND 1943 Some artifact sites of early man in the Great Plains and adjacent areas. Am. Antiq. 8 (3): 242–249. (Biol. Abst. Sec. A 17 (6) 1943).

Central and South America

BORDAS, A. F. 1942 La posición sistemática del Tetraprothomo argentinus Amegh. Rel. Soc. Arg. Anthrop., 3: 53–57.

COLLIER, D., AND J. MURRA 1943 Survey and excavations in Southern Ecuador. Field Mus. Nat. Hist. Anthrop. Ser. vol. 35.

CONSTANZÓ, MARÍA DE LAS MERCEDES 1942 Datos sobre la antropología física de los antiguos habitantes de Cuyo. An. Inst. Etnogr. Am., tomo 3, 323–338.

——— 1942 Antropología calchaquí. La colección Zavaleta del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia." Rev. Inst. Antrop. Univ. Nac. Tucumán, 2 (9): pub. 292 (pp. 214–308).

Cornejo Bouronole, Jorge 1942 Las momias incas. Trepanaciones craneanas en el antiguo Peru. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939). 1: 35–49.

Ekholm, Gordon F. 1942 Excavation at Guasave, Sinaloa, Mexico. Papers Am. Mus. Nat. Hist. 20 (2): 21–139. (sec. on skeletal material, 119–120).

Garcia Frias, J. Elias 1942 La tuberculosis en los antiguos peruanos. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), 1: 99–119.

Guilbert, Henry D. 1943 The Mayan skulls of Copan. Am. J. Orthodont. and Or. Surg. 29: (4): 216–222.

Hurtado, Alberto 1942 La aclimatación del hombre en las grandes alturas dentro del territorio de los Incas. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), 1: 81–91.

Imbelloni, José 1942 Sobre craneología de los Uru, supervivencias de razas Australoides en los Andes. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939). 1: 3–22.

Martinez, del Rio, Pablo 1943 Los Origenes Americanos. Segunda ed. Mexico, p. 366.

Monge, C. M. 1942 La aclimatación del hombre en las alturas dentro del territorio de los Incas. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), 1: 93.

——— 1942 Los problemas relacionados con la raza y la poblacion dentro del territorio de los Incas. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939) 1: 95–97.

Morales Macedo, Carlos 1942 La región del lambda en los antiguos cráneos peruanos. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939) 1: 51–79.

Newman, M. T. 1943 A metric study of undeformed Indian crania from Peru. Am. J. Phys. Anthrop. n.s., 1 (1): 21–46.

Orr, P. C. 1942 The ''Queen'' of Mescalitan Island. Sci. Mo. 54: 482–484.

Posnansky, Arthur 1942 Es o no oriundo el Hombre Americano en America? Actas de la I Sesión del XXVII Congr. Intern. de Amer. (Mexico, 1939). tomo 1: 99–118.

Quevedo, A., Sergio A. 1942 Ensayos de antropología física. Los antiguos pobladores del Cuzco (Región de Calca). Rev. Mus. Nac. Lima, 10 (2): 282–309: 11 (1): 58–96. (Am. J. Phys. Anthrop. n.s. 1 (1): 122–124, 1943).

Rubin de la Borbolla, D. F., J. Comas, E. Davalos, J. Kirchhoff, y M. Maldonado 1942 Las representaciones olmecas desde elpunto de vista antropologico. Mayas y Olmecas. Segunda Reunion de Mesa Redonda sobre problemas antropologicos de Mexico y Centro America: 70–73.

Simoens da Silva, Antônio Carlos 1942 A shell mound or kitchen midden in the State of Rio de Janeiro. Proc. VIII. Am. Sci. Congr., 2: 179–182.

Sivirichi, Atilio 1942 Las deformaciónes artificiales del cráneo en el antiguo Perú. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), 1: 23–25.

Stewart, T. D. 1943 Skeletal remains with cultural associations from the Chicama, Moche, and Virú Valleys, Peru. Proc. U. S. Nation. Mus. 93 (3160): 153–185. (Biol. Abst. Sec. A 17 (6) 1943).

STEWART, T. D. 1943 Skeletal remains from Paracas, Peru. Am. J. Phys. Anthrop., n.s. 1 (1): 47–64.

STRONG, W. D. 1942 Recent archeological research in Latin America. Science, 95: 179–183.

VÉLEZ LÓPEZ, LIZARDO 1942 La cirugía del cráneo en los vasos del Perú precolombino. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), 1: 27–32.

Europe

ANGEL, J. L. 1942 Report on skeletons excavated at Olynthus (pp. 211–240 in D. M. Robinson ''Excavations at Olynthus Pt. X''), Baltimore, J. Hopkins Press. (Am. J. Phys. Anthrop. n.s. 1 (2): 218–219 1943).

ANONYMOUS 1942 Anthropology in Switzerland. Nature. 150 (3796): 150.

——— 1943 Archaelogical finds in the Scottish Southwest Isles. Nature 151 (3827): (Mar. 6).

——— 1943 Relics of our Anglo-Saxon ancestors in the Sixth and Seventh centuries, (at Nassington, near Peterborough) Illus. Lond. News (May 8), 524–525.

——— 1942 The Ipswich man. Nature 149 (3786): 578.

BADEN-POWELL, D. F. W. & J. REID-MOIR 1942 On a new palaeolithic industry from the Norfolk Coast. Geol. Mag. 79 (4).

BOSCH-GIMPERA, P. 1942 Two Celtic waves in Spain. Proc. British Acad. XXVI.

BREUIL, H., M. VAULTIER, ET G. ZBYSZEWSKI 1942 Les plages anciennes portugaises entre les Caps d'Espichel et Carvoeiro et leurs industries paleolithiques. Proc. Prehist. Soc. for 1942, pp. 21–25.

CHILDE, V. G. 1943 Archaeology in the U.S.S.R. ''The Forest Zone.'' Man (Jan. –Feb.) 4–9.

CHILDE, V. G. 1942 Prehistory in the U. S. S. R. I Palaeolithic & mesolithic; II The Copper Age in S. Russia. Man (Sept.–Oct.) pp. 98–103; (Nov.–Dec.) pp. 130–136.

CRAWFORD, O. G. S. 1942 Southampton. Antiquity (March) pp. 44–45.

DAUNCEY, K. D. M. 1942 The stategy of Anglo-Saxon invasion. Antiquity (March) pp. 51–63.

DOHAN, E. H. 1942 Italic tomb-groups in the University Museum. Philadelphia, (U. of Penn. Press).

FIELD, HENRY AND E. PROSTOV 1942 Results of Soviet investigations in Siberia, 1940–1941. Am. Anthrop. 44 (3): 388–406.

GIBSON, H. N. 1942 Northern fringe of the Palaeolithic in England. Nature 149 (3769): 111.

MIGEOD, F. W. H. 1942 Palaeoliths from the Worthing archaeological area. Nature 149 (3781): 444–445.

MINNS, E. H. 1942 Archaeology in Soviet Russia. Man (March–April), p. 46.

——— 1942 Recent archaeological research in Transcaucasia. Nature 150 (3792): 28.

MOVIUS, H. L. 1942 The Irish Stone Age. Cambridge (Cambridge U. Press.).

MYRES, J. N. L. 1942 Cremation and inhumation in the Anglo-Saxon cemeteries. Antiquity (December) pp. 330–341.

New Pallas ed. vi. 1942 A Swiss publication newly organized which contains numerous items of skeletal and prehistoric discoveries. (See Am. J. Arch. 47 (2): 229 ff., 1943).

Riordan, S. P. 1942 The excavation of a large earthen-ring fort at Garranes County Cork. Proc. Royal Irish Acad. 47 (2) Sec. C: 77–150.

Robinson, D. M. 1942 Excavations at Olynthus, Part XI. Necrolynthia, a study in Greek burial customs and anthropology. Baltimore (Johns Hopkins Press).

Schlaginhaufen, Otto 1941–42 Skelette von Bonaduz aus dem Ausgang der La Tené-Zeit. Bull. Schweiz. Gesell. f. Anthrop. u. Ethnol. 18: 42–69.

Ward-Perkins, J. B. 1942 Problems of Maltese prehistory. Antiquity (March) pp. 19–35.

Africa and Asia Minor

Albright, W. F. 1942 Observations on the date of the pottery-bearing stratum of Mughâret Abū Usba. Bull. Am. Schools Orient. Res. (April).

Andrew, G. and A. J. Arkell 1943 A middle Pleistocene discovery in the Anglo-Egyptian Sudan. Nature 151 (3825): 226.

Bochatly, C. 1942 Bibliographic de la Prehistoire Egyptienne, 1869–1938. Soc. Roy. Geogr. Egypte.

Breuil, H. 1942 Pleistocene raised beaches on the west coast of Morocco. Nature 149 (3768): 77–78.

Broom, R. 1942 The hand of the ape-man Paranthropus robustus. Nature 149 (3784): 513–514. (Biol. Abst. Sec. A 17 (1) 1943).

Burkitt, M. C. 1942 South African prehistory. Nature 149 (3773): 225.

Cornwall, P. B. 1943 The Tumuli of Bahrein. Asia, April.

Engberg, R. M. 1942 Tombs of the early Second Millennium from Bāghouz on the Middle Euphrates. Bull. Am. Schools Oriental Res. (Oct.).

Garrod, D. A. E. 1942 Excavations at the Cave of Shukbah, Palestine, 1928. Proc. Prehist. Soc. for 1942. pp. 1–20.

Glueck, Nelson 1943 Archaeological Activity in Palestine and Transjordan in 1941–42. Am. J. Archaeol. 47 (1): 125–131.

Hilzheimer, M. 1942 Animal remains from Tell Asmar. Studies in Ancient Oriental Civilization, Orient, Inst. (U. of Chicago Press).

Joire, J. 1943 Archaeological discoveries in Senegal. Man (May–June) pp. 49–52.

Kantor, H. J. 1942 The early relations of Egypt with Asia. J. Near East. Studies 1(2): April.

Kent, P. E. 1942 The Pleistocene beds of Kanam and Kanjera, Kavirando, Kenya. Geol. Mag. 76 (2): March–April.

Leakey, L. S. B. 1942 The Nawasha fossil skull and skeleton. J. E. Afr. Nat. Hist. Soc. 16: 169–177.

Lloyd, Seton and Safar Fuad 1943 Tell Uqair-excavations by the Iraq Government Directorate of Antiquities in 1940–1941. J. Near East. Studies 2 (2): April.

McCown, D. E. 1942 The material culture of Early Iran. J. Near East. Studies 1 (4): Oct.

MORANT, G. M. 1942 The earliest known inhabitant of Central Asia. Man 42: 71–72. (Biol. Abst. Sec. A 17 (6) 1943).

STEKELIS, M. 1942 Preliminary report on soundings in prehistoric caves in Palestine. Bull. Am. Schools Orient. Res. (April).

——— 1943 Further observations on the chronology of Mughâret Abū Usba. Bull. Am. Schools Orient. Res. (Feb.)

WAYLAND, E. J. 1943 A Middle Pleistocene discovery in the Anglo-Egyptian Sudan. Nature 151 (3829): 334.

WINLOCK, H. E. 1942 Excavations at Deir el Bahri 1911–31. New York (Macmillan Co.).

WULSIN, F. R. 1942 The prehistoric archaeology of N. W. Africa. Papers Peabody Mus. Am. Archaeol. Ethnol., Harvard.

Asia and Oceania

ANONYMOUS 1942 The Gujaret prehistoric expedition. Science 96 (2502): 530–531.

DERANIYAGALA, P. 1942 Ground and polished artifacts from Ceylon. Nature 149 (3779): 384–385.

DE TERRA, H., AND H. MOVIUS 1943 Research on early man in Burma. Trans. Am. Philos. Soc.

KROGMAN, W. M. AND W. H. SASSAMAN 1943 Skull found at Chanhu-daro (pp. 252–263 in Chanhu-daro excavations, 1935–36 by E. J. H. Mackay) Vol. 20 of Amer. Oriental series Am. Orient Soc., New Haven, Conn.

LAYARD, JOHN 1942 Stone men of Malekula. London (Chacto & Windus).

SCOTT, S. 1942 Neolithic culture of the Hebrides. Antinquity (December) pp. 301–306.

III. EVOLUTION AND COMPARATIVE ANATOMY (incl. PRIMATES)

CAMP, W. H. 1942 Continental displacement and the origin of the American floras. Proc. Eighth Amer. Sci. Congr. 3: 193–194. (Biol. Abst. Sec. A 17 (3) 1943).

CHASE, R. E. 1942 Lung lobation in rhesus monkey, compared with man. Am. J. Phys. Anthrop. 29 (2): 267–286. (Biol. Abst. Sec. B 16 (10) 1942).

COKER, R. E. 1942 What are the fittest? Sci. Mo. 55 (6): 487–494.

CRAWFORD, M. P. 1942 Dominance and the behavior of pairs of female chimpanzees when they meet after varying intervals of separation. J. Comp. Psychol. 33: 259–265.

——— 1942 Dominance and social behavior, for chimpanzees, in a non-competitive situation. J. Comp. Psychol., 33: 267–277.

DOBZHANSKY, T. 1942 Biological adaptation. Sci. Mo. 55 (5): 391–402.

EVANS, A. T. 1942 A new concept of origin and evolution. Proc. Indiana Acad. Sci. 51: 22–29. (Biol. Abst. Sec. A 16 (10) 1942).

FAWCETT, D. W. 1942 The amedullary bones of the Florida manatee (Trichechus latirostris). Am. J. Anat. 71 (2): 271–330.

Gregory, W. K. 1943 Environment and locomotion in mammals. Nat. Hist. (May), pp. 222–227.

Grether, W. F. 1942 The magnitude of simultaneous color contrast and simultaneous brightness contrast for chimpanzee and man. J. Exper. Psychol., 30: 69–83.

Hooton, E. A. 1942 Man's poor relations. New York (Doubleday Doran). (Am. J. Phys. Anthrop. n.s., 1 (2): 215–218 1943).

Horton, P. B. 1942 Does history show long-time trends? Sci. Mo. 55 (5): 461–470.

Huxley, Julian 1942 Evolution: the modern synthesis. New York (Harper Bros.).

Mayr, Ernst 1942 Systematics and the origin of species. New York (Col. U. Press). (Biol. Abst. Sec. A 17 (6) 1943).

McAtee, W. L. 1942 The cause of domestication. (Biol. Abst. Sec. A 17 (2) 1943).

Nissen, H. W. 1942 Studies of infant chimpanzees. Science, 95: 159–161.

——— 1942 Ambivalent cues in discriminative behavior of chimpanzees. J. Psychol. 14: 3–33.

Noback, C. R. 1943 The placentation of a guinea baboon (Papio papio). (Abst. from Suppl. Anat. Rec. 35 (3) March, 1943).

Osborn, H. F. 1942 Ed. by Mabel R. Percy. Proboscidea. A Monograph of the discovery, evolution, migration and extinction of the Mastodonts and elephants of the World. Vol. II. Stegodontoidea, Elephantoidea. New York (American Museum Press), 805–1675. 30 plates.

Scholander, P. F., L. Irving and S. W. Grinnell 1942 On the temperature and metabolism of the seal during diving. J. Cell. and Comp. Physiol., 19 (1): 67–78.

Shull, A. F. 1942 Two decades of evolution theory. Am. Nat. 76 (763): 171–178. (Biol. Abst. Sec. A 16 (9) 1942).

Straus, W. L., jr. 1942 The structure of the crown-pad of the gorilla and of the cheek-pad of the orang-utan. J. Mammal. 23 (3): 276–281. (Biol. Abst. Sec. A 17 (6) 1943).

Washburn, S. L. 1942 Skeletal proportions of adult langurs and macaques. Hum. Biol. 14 (4): 444–472. (Biol. Abst. Sec. A 17 (4) 1943).

——— 1942 Technique in primatology. I. Anthrop. Briefs 1 (1): 6–12. (Biol. Abst. Sec. A 17 (5) 1943).

Wilhelmi, R. W. 1942 The application of the precipitin technique to theories concerning the origin of vertebrates. Biol. Bull. 82 (2): 179–189. (Biol. Abst. Sec. A 16 (8) 1942).

Wislocki, George B. 1942 Size, weight, and histology of the testes in the gorilla. J. Mammal. 23 (3): 281–287. (Biol. Abst. Sec. A 17 (6) 1943).

IV. CRANIOLOGY AND OSTEOLOGY

Craniology

Comas, Juan 1943 El Metopismo: sus causas y frecuencia en los cráneos mexicanos. An. Inst. Etnogr. Am. tomo 4, pp. 121–159.

Goldstein, M. S. 1943 Observations on Mexican crania. Am. J. Phys. Anthrop. n.s. 1 (1): 86–94.

HRDLIČKA, ALEŠ 1943 Skull of a midget from Peru. Am. J. Phys. Anthrop. n.s., 1 (1): 77–82.

NEUMANN, G. 1942 American Indian crania with low vaults. Hum. Biol. 14 (2): 178–191.

ORBAN, BALINT 1942 Sclerotic areas in skulls affected with Paget's disease. Arch. Path. 33 (5): 607–618. (Biol. Abst. Sec. B 16 (9) 1942).

SCHULTZ, A. H. 1942 Conditions for balancing the head in primates. Am. J. Phys. Anthrop. 29 (4): 483–497. (Biol. Abst. Sec. A 17 (4) 1943).

SIMMONS, K. 1942 Cranial capacities by both plastic and water techniques with cranial linear measurements of the Reserve collection; White and Negro. Hum. Biol. 14 (4): 473–498. (Biol. Abst. Sec. A 17 (4) 1943).

WELLS, R. J. 1942 A diminutive skull from Peru. Am. J. Phys. Anthrop. 29 (3): 425–427.

Osteology of head and vertebral column

CHASE, S. W. 1942 The early development of the human pre-maxilla. J. Am. Dent. Assoc. 29 (11): 1991–2001. (Biol. Abst. Sec. B 17 (2) 1943).

CHRISTOPHER, F. R. 1942 A histological study of bone healing in relation to the extraction of teeth. Northwestern Univ. Bull. 43 (7): 5–11. (Biol. Abst. Sec. B 17 (5) 1943).

COMAS, JUAN 1942 El hueso interparietal, epactal o inca en los cráneos mexicanos. An. Escuela Nac. Cien. Biol. vol. 2, no. 4, pp. 469–490.

EATON, T. H. JR. 1943 An adaptive series of protractile jaws in Cichlid fishes. J. Morph., 72 (1): 183–190.

HABOUSH, E. J. 1942 An anatomical explanation of traumatic low-back pain. J. Bone and Joint Surg. 24: 123–134.

KLEINBERG, S., AND M. S. BURMAN. Spondolisthesis. J. Bone and Joint Surg. 24: 899–906.

KURTH, L. E. 1942 Mandibular movements in mastication. J. Am. Dent. Assoc. 29 (10): 1769–1790. (Biol. Abst. Sec. B 17 (3) 1943).

LLEWELLYN, J. S., AND A. D. BIGGS 1943 Hypoplasia of mandible; report of case, with resume of literature and suggestions for modified form of treatment. Am. J. Dis. Child. 65: 440–444.

LOUW, H. H. 1942 An interesting lower jaw. S. Afr. Dent. J. 16: 41. (Biol. Abst. Sec. B 16 (8) 1942).

MONTAGU, M. F. A. 1943 The mesethmoid-presphenoid relationships in the primates. Am. J. Phys. Anthrop., n.s. 1(2): 129–142.

——— 1942 Unique development of the premaxilla in the gorilla. Am. J. Phys. Anthrop., 29 (3): 417–423.

PENDLETON, G. C. 1942 The minute anatomy of the lower jaw in relation to the denture problem. J. Am. Dent. Assoc. 29 (5): 719–736. (Biol. Abst. Sec. B 16 (9) 1942).

PHEASANT, H. C., AND P. C. SWENSON 1942 The lumbosacral region. J. Bone and Joint Surg. 24: 299–306.

SENSENIG, E. C. 1943 The origin of the vertebral column in the deer-mouse, Peromyscus maniculatus rufinus. Anat. Rec., 86 (2): 123–142.

Sprague, J. M. 1943 The hyoid region of placental mammals with especial reference to the bats. Am. J. Anat., 72 (3): 385–472.

Thompson, J. R., and A. G. Brodie 1942 Factors in the position of the mandible. J. Am. Dent. Assoc. 29 (6): 925–941. (Biol. Abst. Sec. B 16 (9) 1942).

Williams, J. L. 1942 The development of cervical vertebrae in the chick under normal and experimental conditions. Am. J. Anat., 71 (2): 153–180.

Osteology of arm

Bost, F. C., and V. T. Inman 1942 The pathological changes in recurrent dislocation of the shoulder. J. Bone and Joint Surg. 24: 595–613.

Bremer, J. L. 1942 The influence of estrogens on the shape of long bones. J. Bone and Joint Surg. 24: 32–37.

Gray, D. J. 1942 Variations in human scapulae. Am. J. Phys. Anthrop. 29 (1): 57–72. (Biol. Abst. Sec. B 16 (7) 1942).

Hrdlička, Aleš 1942 The scapula: visual observations. Am. J. Phys. Anthrop. 29 (1): 73–94. (Biol. Abst. Sec. B 16 (7) 1942).

——— 1942 The juvenile scapula: further observations. Am. J. Phys. Anthrop. 29 (2): 287–310. (Biol. Abst. Sec. B 16 (10) 1942).

——— 1942 The adult scapula. Additional observations and measurements. Am. J. Phys. Anthrop. 29 (3): 363–416.

Moore, B. H. 1942 Macrodactyly and associated peripheral nerve changes. J. Bone and Joint Surg. 24: 617–631.

Saunders, R. L. de C. H. 1942 The os epipyramis or epitriquetrum. Anat. Rec. 84 (1): 17–22.

Terry, R. J. 1943 The inclination of the saddle surface of the trapezium with respect to the angle between the thumb and wrist. Am. J. Phys. Anthrop., n.s. 1 (2): 157–170.

Wolff, C., and H. R. Rollin 1942 The hands of Mongolian imbeciles in relation to their three personality groups. J. Mental Sci. 88: 415–418.

Osteology of leg

Abbott, L. C., and G. G. Gill 1942 Valgus deformity of the knee resulting from injury to the lower femoral epiphysis. J. Bone and Joint Surg., 24: 97–113.

Barber, C. G. 1942 Osteochondrosis deformans tibiae: nonrachitic bowleg in children. Am. J. Dis. Child. 64 (5): 831–842.

Barlow, T. E. 1942 Os cuneiform 1 bipartitum. Am. J. Phys. Anthrop. 29 (1): 95–111. (Biol. Abst. Sec. B 16 (7) 1942).

Canas, L. B., et al. 1942 Promedio de las medidas externas de la pelvis de la mujer Costarricense. Rev. Med. (San José) 5 (94): 127–129.

Weaver, J. B. 1942 Calcification and ossification of the menisci. J. Bone and Joint Surg. 24: 873–882.

V. THE TEETH

General references, including jaw movements

ANDERSON, B. G. 1942 Developmental enamel defects: clinical descriptions and classification. Am. J. Dis. Child. 63 (1): 154–163.

BÖEDICKER, C. F., AND W. J. GIES 1942 Character of age changes in enamel and dentine and their relation to vital dental pulp, with critical analysis. J. Am. Coll. Dentists 9: 380–399.

BREITNER, C. 1942 Occlusal changes induced by experimental interference with masticating muscles. (Abst.) J. Dent. Res. 21: 300–301.

BROADBENT, B. H. 1943 The influence of the third molars on the alignment of the teeth. Am. J. Orthodont. Oral Surg. 29: 312–330.

CAWSTON, F. GORDON 1942 The dentition of adult dogs. S. Afr. Dent. J. 16: 167–168. (Biol. Abst. Sec. B 17 (1) 1943).

COHEN, J. T., C. P. OLIVER AND S. BERNICK 1942 Dental studies of triplets; measurements of arch width and length. J. Dent. Res. 21: 223–239.

COSTEN, J. B. 1942 Reflex effects produced by abnormal movement of lower jaw. Arch. Otolaryng. 36: 548–555.

GINN, J. T., AND V. H. POWELL 1942 Effect of extraction of the second molar on the movement of the first and third molars in rats. (Abst.) J. Dent. Res. 21: 301.

GREGORY, W. K. 1943 The earliest known fossil stages in the evaluation of oral cavity and jaws. Am. J. Orthodont. and Oral Surg. 29: 253–276.

HELLMAN, M. 1942 Factors influencing occlusion. Angle Orthodont. 12: 3–27.

JASPERSON, C. P. 1942 Oral manifestations as seen in pediatrics. Texas State J. Med. 38: 330–331.

KOHN, S. I. 1942 Treatment of temporomandibular dysfunction accompanied by severe pain syndrome. Am. J. Orthodont. 28: 302–310.

KURTH, L. E. 1942 Mandibular movements in mastication. J. Am. Dent. Assoc. 29: 1769–1790.

MONTAGU, M. F. ASHLEY 1942 Unique development of the premaxilla in the gorilla. Am. J. Phys. Anthrop. 29 (3): 417–423.

NEWMAN, J. 1942 Repair of prognathic and retruded jaws. Am. J. Surg. 58: 35–39.

PENDLETON, E. C. 1942 Minute anatomy of lower jaw in relation to denture problem. J. Am. Dent. Assoc. 29: 719–736.

SALZMANN, J. A. 1942 Correlation of early loss of permanent first molar to site of second premolar eruption. (Abst.) J. Dent. Res. 21: 300.

——— 1942 Influence of loss of permanent first molar extraction on position of eruption of second premolar. J. Dent. Res., 21 (5): 489–492.

SARNAT, B. G., AND W. E. HOOK 1942 Tooth development in hibernation. (Abst.) J. Dent. Res. 21: 336.

SCHER, S. L. 1942 Deformed chin and lower jaw. Ann. Surg. 115: 869–879.

SCHOUR, I., AND M. MASSLER 1942 The development of the teeth. J. Canadian Dental Assoc. 8 (11): 529–533. (Biol. Abst. Sec. B 17 (4) 1943).

SCHUYLER, C. H. 1942 Effect of abnormalities of occlusion upon temporomandibular joint and associated structures. Proc. Dent. Center Celeb. 303–308.

SEAVER, E. P. 1942 Neuromuscular control of mandible. Am. J. Orthodont. 28: 222–229.

SHAPIRO, H. H., ET AL. 1942 Role of the dental papilla in early tooth formation. I. (Abst.) J. Dent. Res. 21: 301–302.

SILLMAN, J. H. 1942 Malocclusion in deciduous dentition: serial study from birth to 5 years. Am. J. Orthodont. and Oral Surg. 28 (4): 199–209. (Biol. Abst. Sec. B 16 (8) 1942).

STAZ, J. 1942 A case of fourth molars and macrodontia. S. Afr. Dent. J. 16 (6): 200–206. (Biol. Abst. Sec. B 17 (1) 1943).

STEIN, S. H. 1942 Correcting dento-facial disharmonies. Bull. Hosp. Joint. Dis. 3: 54–57.

TAYLOR, W. 1942 Supernumerary teeth. M. Bull. Vet. Admin. 18: 337.

VALENTINE, B. 1942 Correlation of malformations. Rev. Brasil de cir. 11: 357–378.

YOUNG, F. 1942 Function of lower jaw following partial resection. Surgery II, 966–982.

ZENO, L. 1942 Anomalies of maxillary angle; Albrecht's lemurine apophysis. An. de cir. 8: 48–51.

The eruption of the teeth

BRAUER, J. C., AND M. A. BAHADOR 1942 Variations in calcification and eruption of the deciduous and the permanent teeth. J. Am. Dent. Assoc. 29: 1373–1387.

CAWSTON, F. GORDON 1942 A consideration of the successional theory of teeth. Current Sci. 11 (8): 329–330. (Biol. Abst. Sec. B 17 (6) 1943).

DOERING, C. R., AND M. F. ALLEN 1942 Data on eruption and caries of the deciduous teeth. Child Devel. 13 (2): 113–129. (Biol. Abst. Sec. B 17 (2) 1943).

ROBINOW, M. T., W. RICHARDS, AND M. ANDERSON 1942 The eruption of deciduous teeth. Growth 6 (2): 127–133. (Biol. Abst. Sec. B 17 (1) 1943).

SCHWARTZMAN, J. 1942 Derangements of deciduous dentition. Arch. Pediat., 59: 188–197.

STEGGERDA, MORRIS, AND T. J. HILL 1942 Eruption time of teeth among Whites, Negroes and Indians. Am. J. Orthod. and Oral Surg., 28 (6): 361–370.

THELANDER, H. E. 1942 A five-year clinical study of factors affecting first dentition. J. Pediat., 20: 187–199.

Racial differences in teeth

CONSTANZÓ, MARÍA DE LAS MERCEDES 1942 Lesiones dentarias en los indígenas prehispanicos. Rel. Soc. Arg. Antrop. 3: 241–252.

DEMBO, ADOLFO, AND OSVALDO L. PAULOTTI 1942 Dos mujeres Izozó con mutilaciones dentarias intencionales. Considerationes sobre la technica, significado y difusion del aguzamiento en Sud America. Rel. Soc. Arg. Antrop., 3: 157–172.

FOSTER, L. W. 1942 Dental conditions in white and Indian children in northern Wisconsin. J. Am. Dental Assoc. 29 (19): 2251–2255. (Biol. Abst. Sec. B 17 (4) 1943).

GARCIA BEDOYA, JOSÉ M. 1942 Prevalencia de los procesos destructivos de los dientes en las razas antiguas peruanas. Bol. Escuela Odont. Lima, 1er sem., pp. 9–19.

HEALEY, H. J., AND V. D. CHEYNE 1942 Dental conditions of Indina University freshman students (Abst.) J. Dent. Res., 21: 312.

JOHNSON, FREDERICK 1943 Tooth mutilation among the Guaymi. Am. Anthrop. n.s. 45: 327–328.

RABKIN, S. 1942 Dental conditions among prehistoric Indians of Northern Alabama. J. Dent. Res. 21 (2): 211–222.

STEGGERDA, M., AND T. J. HILL 1942 Eruption time of teeth among White, Negro, and Indian. Am. J. Orthodont and Oral Surg. 28 (6): 361–370. (Biol. Abst. Sec. B 16 (10) 1942).

STEWART, T. D. 1942 Persistence of the African type of tooth pointing in Panama. Am. Anthrop., n.s., 44: 328–330.

WRIGHT, H. B. 1942 A frequent variation of the maxillary central incisors, with some observations on dental caries among the Jivaro (Shura) Indians of Ecuador. Proc. VIII Am. Sci. Congr., 2: 237–240.

Dental caries and diets of various peoples

BELL, B. 1942 Caries and malocclusion. Texas State J. Med. 38: 346–349.

BRINTON, H. P., D. C. JOHNSTON AND E. O. THOMPSON 1942 Dental status of adult male mine and smelter workers. Pub. Health Rep., 57: 218–228. (Biol. Abst. Sec. B. 16 (8), 1942).

CHAPIN, R. W., AND C. A. MILLS 1942 Dental caries in the Panama Canal Zone. J. Dent. Res. 21 (1): 55–60.

CHEYNE, V. D. 1942 Human caries and topically applied fluorine; preliminary report. J. Am. Dent., Assoc. 29: 804–807.

COHEN, B. 1942 A preliminary survey of the oral condition of Bantu citrus workers. S. Afr. Dent. J. 16: 155–159. (Biol. Abst. Sec. B 16 (9) 1942).

EAST, B. R. 1942 Dental caries rates and mouth age of teeth. J. Dent. Res. 21 (2): 125–134.

EAST, B. R., AND K. POHLEN 1942 Dental caries among school children of Bergen County, New Jersey. J. Dent. Res., 21 (2): 115–124.

——— 1942 Trend in attack rate of dental caries of 358 U. S. Counties (Abst.) J. Dent. Res. 21: 332.

FOSDICK, L. S. 1942 The etiology and control of dental caries. J. Am. Dent. Assoc. 29: 2132–2139.

GAFAFER, W. M. 1942 The measurement and comparison of dental caries experience. J. Dent. Res., 21 (5) 443–454.

GUNTER, J. H. 1942 Teeth: significance in deficiency disease. Penn. Med. J. 45: 1081–1083.

HINDS, F. W. 1942 Form of contact surfaces and their relationship to caries susceptibility. J. Dent. Res. 21 (5): 473–474.

Howe, P. R., R. L. White, and M. D. Elliott 1942 The influence of nutritional supervision on dental caries. J. Am. Dent. Assoc. 29 (1): 38–43. (Biol. Abst. Sec. B 16 (8) 1942).

Klatsky, M. 1942 Masticatory stresses and their relation to dental caries. J. Dent. Res. 21 (4): 387–390.

——— 1942 Masticatory stresses and their relation to dental caries. (Abst.) J. Dent. Res. 21: 319–320.

Klein, H. 1942 Susceptibility to dental caries and family income. (Abst.) J. Dent. Res. 21: 320–321.

——— 1943 Tooth mortality and socio-economic status-life tables for teeth. J. Am. Dent. Assoc. 30 (1): 80–95. (Biol. Abst. Sec. B 17 (5) 1943).

Klein, H., and J. W. Knutson 1942 Studies on dental caries. XIII. Effect of ammoniacal silver nitrate on caries in the first permanent molar. J. Am. Dent. Assoc. 29: 1420–1426.

Livermore, A. R. 1942 Vitamins and minerals in the prevention of caries. Report of 2-year experiment with 84 children. Dental Survey 18: 1169. (Biol. Abst. Sec. B 17 (1) 1943).

McBeath, E. C., and W. A. Veclin 1942 Further studies on the role of vitamin D in the nutritional control of dental caries in children. J. Am. Dent. Assoc. 29: 1393–1397.

Meyer 1941 Der Einfluss des Zuckers auf die Entwicklung der Zähne. Deutsch. zahnärztl. Wochenschr., 44, 205. (Nut. Abst. Rev. 12 (3), 1943).

Murray, M. M., and D. C. Wilson 1942 Caries in London school children. Lancet 1: 98–99. Jan. 1942.

Reed, J. J. 1942 Dental caries. J. Am. Dent. Assoc. 29: 88–91.

Siegel, E. H., et al. 1942 Tooth development and dental caries in children with prolonged severe disturbances affecting growing bones. (Abst.) J. Dent. Res. 21: 336–337.

Statz, J. 1943 Hypoplastic teeth and caries. S. Afr. Med. J. 17: 1–4.

Taylor, D. 1942 Preliminary studies on caries immunity in the Deaf Smith County, (Texas) area. J. Am. Dent. Assoc. 29 (3): 438–444. (Biol. Abst. Sec. B 16 (9) 1942).

Weiman, J. P., G. W. Wessinger, and G. Reed 1942 Correlation of chemical and histologic investigations on developing enamel. J. Dent. Res. 21: 171–182.

The role of the endocrines and the effects of disease on the teeth

Aguirre, R. C., S. de Alzaga, and S. S. Lundhald 1942 Rickets and dentition. Dia med. 14: 1042.

Altana, V. 1942 Hypophyseal origin of metabolic craniopathies; care of hyperostosis. Med. Spain. 8: 495–497.

Anderson, B. G. 1942 Developmental enamel defects; clinical description and classification. Am. J. Dis. Child. 63: 154–163.

Brodie, A. J., and B. G. Sarnat 1942 Ectodermal dysplasia (anhidrotic type) with complete anodontia; serial roentgenographic cephalometric appraisal. Am. J. Dis. Child. 64: 1046–1054.

Brucker, M. 1943 Studies on the incidence and cause of dental defects in children. I. prophylaxis. J. Dent. Res. 22:107.

———— 1943 Studies on the incidence and cause of dental defects in children. II. Hypoplasia. J. Dent. Res. 22:115.

Hardgrove, T. A. 1942 Glandular and general systemic factors in the process of decay. J. Am. Dent. Assoc. 29: 1803–1807.

Ley, A., J. Pons Tordera 1942 Crauzon's craniofacial dysostosis, with report of a case. Med. Espan. 7: 539–549.

Loobey, J. P., and L. W. Burket 1942 Scleroderma of face with involvement of alveolar process. Am. J. Orthod. 28: 493–498.

Miller, S. C., and B. B. Seidler 1942 Relative alveoloclastic experience of the various teeth. (Abst.) J. Dent. Res. 21: 311–312.

Munilla, A., and J. R. Marcos 1942 Endocrinopathis and congenital anomalies, cases, Arch. pedat. Uruguay. 13: 321–323.

Sarnat, B. G., and Noel G. Shaw 1942 Dental development in congenital syphilis. Am. J. Dis. Child. 64 (5): 771–788. (Biol. Abst. Sec. B 17 (4) 1943).

Sarnat, B. G., and I. Schour 1941 and 1942 Enamel hypoplasia (chronologic enamel aplasia) in relation to systematic disease; a chronologic, morphologic and etiologic classification. J. A. Dent. Assoc., 1989–2000; 29: 67–75.

Schour, Isaac and M. Massler 1943 Endocrines and Dentistry. J. Am. Dent. Assoc.: 30 (7): 595–603; (9): 763–773; (11): 943–950.

Spitzer, R. 1942 Enamel hypoplasia in idiopathic epilepsy. Brit. Med. J. 1: 110.

Stathers, F. R. 1942 Malocclusion and congenital syphilis. Am. J. Orthodont. 28: 138–151.

Winter, G. R. 1943 Development of teeth in cleidocranial dyostosis. Am. J. Orthodont. 29: 61–89.

VI. BRAIN AND NERVES

Central Nervous System

Alder, A. 1942 Melanin pigment in the brain of the gorilla. J. Comp. Neur., 76 (3): 501–507.

Appel, F. W., and E. M. Appel 1942 Intracranial variation in the weight of the human brain. Hum. Biol. 14 (1): 48–68; 14 (2): 235–250.

Bailey, Percival, et al. 1943 Functional organization of the medial aspect of the primate cortex. (Abst. from Suppl. Anat. Rec. 35 (3) March 1943).

Barcroft, Joseph, and D. H. Barron 1942 Observations on the functional development of the foetal brain. J. Comp. Neur., 77 (2): 431–454.

von Bonin, G. 1942 The striate area of primates. J. Comp. Neur., 77 (2): 405–430.

———— 1943 The areal pattern of the precentral motor cortex in primates. (Abst. from Suppl. Anat. Rec. 35 (3) March 1943).

von Bonin, G., H. W. Garol, and W. C. McCulloch 1942 The functional organization of the occipital lobe. Biol. Symposia, 7: 165.

Connolly, C. J. 1942 The fissural pattern in the brain of Negroes and Whites (continued). The parietal and temporal lobes. Am. J. Phys. Anthropol. 29 (2): 225–250. (Biol. Abst. Sec. B 16 (10) 1942).

Evans, W. A. 1942 An encephalographic ratio for estimating the size of the cerebral ventricles: further experience with serial observations. Am. J. Dis. Child. 64 (5): 820–830.

Kreig, W. J. S. 1942 Functional neuroanatomy. Philadelphia (Blakiston Co.).

Kuntz, Albert 1942 A text-book of neuro-anatomy. 3rd ed., Rev. Philadelphia (Lea and Febiger).

Larsell, Olof 1942 Anatomy of the nervous system. A textbook from the developmental and functional point of view, and atlas of the nervous system of man. New York (D. Appleton-Century Co.).

Lassek, A. M. 1942 The human pyramidal tract. IV. A study of the mature, myelinated fibers of the pyramid. J. Comp. Neur., 76 (2): 217–226.

Peele, T. L. 1942 Cytoarchitecture of individual parietal areas in the monkey (Macaca mulatta) and the distribution of the efferent fibers. J. Comp. Neur., 77 (3): 693–738.

Romer, A. S., and Tilly Edinger 1942 Endocranial casts and brains of living and fossil amphibia. J. Comp. Neur., 77 (2): 355–390.

Rose, J. E. 1942 A cytoarchitectural study of the sheep cortex. J. Comp. Neur., 76 (1): 1–56.

Peripheral Nerves

Arey, L. B., S. R. Bruesch, and S. Castanares 1942 The relation between eyeball size and the number of optic nerve fibers in the dog. J. Comp. Neur., 76 (3): 417–422.

Breusch, S. R., and L. B. Arey 1942 The number of myelinated and unmyelineated fibers in the optic nerve of vertebrates. J. Comp. Neur., 77 (3): 631–666.

Chiu, S. L. 1943 The superficial hepatic branches of the vagi and their distribution to the extrahepatic biliary tract in certain mammals. Anat. Rec. 86 (2): 149–156.

Corbin, K. B., and F. Harrison 1942 Further attempts to trace the origin of afferent nerves to the extrinsic eye muscles. J. Comp. Neur., 77 (1): 171–186.

Reed, A. F. 1943 The relations of the inferior laryngeal nerve to the inferior thyroid artery. Anat. Rec., 85 (1): 17–24.

Sahs, A. L. 1942 Vascular supply of the monkey's spinal cord. J. Comp. Neur., 76 (3): 403–416.

VII. SEROLOGY AND SPLANCHNOLOGY

Blood

Arcila Velez, Graciliano 1943 Grupos sanguíneos entre los indios Páez. Rev. Inst. Etnol. Nac. Bogotá, vol. 1, pp. 7, 14.

Basu, B. N., and M. N. Basu 1942 Physical anthropology of the Bhuryas of Mayurbhang. Sci. and Culture 7 (11): 571–572. (Biol. Abst. Sec. A 17 (1) 1943).

BERNHART, H. 1942 Beitrag zur blutgruppengeographie Grossdeutschlands. Zeitschr. Hyg. u. infektíonskrankh. 123 (6): 675–697. (Biol. Abst. Sec. A 17 (5) 1943).

CANDELA, P. B. 1942 The introduction of blood-group B into Europe. Hum. Biol. 14 (4): 413–443.

——— 1943 Blood group tests on tissues of Paracas mummies. Am. J. Phys. Anthrop. n.s. 1 (1): 65–68.

COMAS, JUAN 1942 Aportación a la bibliografía y estadistica serológica racial Americana. Bol. Bibl. Antrop. Am. vol. 5, pp. 29–37.

——— 1942 Los grupos sanguineos y la raciologia americana Rev. Mexicana Soc., vol. 4, no. 3; pp. 69–73.

FARRIS, E. J. 1943 The blood picture of athletes as affected by intercollegiate sports. Am. J. Anat., 72 (2): 223–258.

FERGUSON, L. C., C. STORMONT AND M. R. IRWIN 1942 On additional antigens in the erythrocytes of cattle. J. Immunol. 44 (2): 147–164.

HERNANDEZ MORALES, F. 1942 Blood studies in Puerto Rican children. Puerto Rico J. Pub. Health, 17, 387–393. (Nut. Abst. Rev. 12 (3) 1943).

HYMAN-PARKER, H. S. 1942 The development of the agglutinogens M and N in newborn infants; with notes on the agglutinogens A and B. J. Immunol. 43 (1): 1–12.

KNOPFMACHER, H. P. 1942 A study of four antigenic components of rabbits' erythrocytes. J. Immunol. 44 (2): 121–128.

LANDSBERG, J. W. 1942 The blood picture of mature normal dogs. Anat. Rec. 84 (4): 415–422.

LEHMAN, HENRI, L. DUQUE AND M. FORNAGUERA 1943 Grupos sanguineos entre los indios—Guambiano—Kokonuko. Rev. Inst. Etnol. Nac. Bogota, vol. 1; entrega la.; pp. 197–208.

LEVINE. PHILIP 1942 On human anti-Rh sera and their importance in racial studies. Science 96 (2498): 452–453. (Biol. Abst. Sec. A 17 (4) 1943).

MAJUMDAR, D. N. 1943 The blood groups of the Dons. Current Sci. 11 (4): 153–154. (Biol. Abst. Sec. A 17 (4) 1943).

PONS MUSSO, JULIO 1942 Estudios hematológicos en el recién nacido. Actas y Trabajos Cient. XXVII Congr. Intern. Am. (Lima, 1939), tomo 1, p. 121.

ROBERTS, J. A. 1941–1942 Bllood group frequencies in North Wales. Ann Eugenics 11 (3): 260–271. (Biol. Abst. Sec. A 17 (3) 1943).

SAWIN, P. B., C. A. STUART, AND K. M. WHEELER 1943 Pictorial presentation of antigen and antibody relations: associated with the "A" character in the rabbit. J. Herod. 34 (6): 179–186.

SARKAR, S. S. 1942–1943 Analysis of Indian blood group data with special reference to the Oraons. Trans. Bose Res. Inst. 15: 1–15. (Biol. Abst. Sec. A 17 (6) 1943).

URIZAR, R. 1942 Los grupos sanguineos y su empleo en la clasificacion de las razas, en Medicina legal y en la patogenia de las enfermedades. Asuncion-Paraguay.

——— 1942 Grupos sanguineos de autóctonos del Chaco Paraguayo. Am. Indigena 2 (4): 49–50.

Wiener, A. S. 1942 The RH factor and racial origins. Science 96 (2496): 407–408. (Biol. Abst. Sec. A 17 (3) 1943).

Wiener, A. S., P. B. Candela, and L. J. Goss 1942 Blood-group factors in the blood, organs and secretion of primates. J. Immunol. 45 (3): 229–236.

Arteries and veins

Conn, L. C., J. Calder, J. W. MacGregor and R. F. Shaner 1942 Report of a case in which all pulmonary veins from both lungs drain into the superior vena cava. Anat. Rec., 83 (3): 335–340.

Cohen, H. H. 1942 Strain thrombosis of the axillary vein. J. Bone and Joint Surg. 24: 452–457.

Lev, M., and O. Saphir 1942 Truncus arteriosus communis persistens. J. Pediat. 20: 74–88.

Mickels, N. A. 1942 The variational anatomy of the spleen and splenic artery. Am. J. Anat., 70 (1): 21–72.

Pick, J. W., B. J. Anson, and F. L. Ashley 1942 The origin of the obturator artery. A study of 640 body-halves. Am. J. Anat., 70 (2): 317–344.

Stanton, W. B. 1943 Report of an exceptional case of lienal arterial tortuosity. Anat. Rec. 85 (2): 157–162.

Vann, H. M. 1943 A note on the formation of the plantar arterial arch of the human foot. Anat. Rec., 85 (3): 269–276.

Viscera

Barden, R. B. 1943 Changes in the pigmentation of the iris in metamorphosing amphibian larvae. J. Exp. Zool., 92 (2): 171–198.

Congdon, E. D., Ralph Blumberg, and William Henry 1942 Fasciae of fusion and elements of the fused enteric mesenteries in the human adult. Am. J. Anat., 70 (2): 251–280.

Detwiler, S. 1943 Vertebrate photoreceptors. New York (Macmillan and Co.). Exp. Biol. Monographs.

Gushue-Taylor, G., and Ralph Hayward 1942 A case of right duodenal hernia. Anat. Rec., 83 (3): 389–400.

Kingsbury, B. F. 1943 On the so-called laryngeal tonsils of mammals; with special reference to their structure and development in the cat. Am. J. Anat., 72 (2): 171–198.

Kramer, T. C. 1942 The partitioning of the truncus and conus and the formation of the membranous portion of the interventricular septum in the human heart. Am. J. Anat., 71 (3): 343–370.

Lachman, Ernest 1942 A comparison of the posterior boundaries of lungs and pleura as demonstrated on the cadaver and on the roentgenogram of the living. Anat. Rec., 83 (4): 521–542.

Latimer, H. B., and C. Wolfson 1943 A case of hernia in the superior duodenal fossa. (Abst. from Suppl. Anat. Rec. 35 (3) March, 1943).

Riddell, W. J. B. 1941–1942 Studies on the classification of eye color. Ann. Eugen. 11 (3): 245–259.

SMITH, D. E., AND F. A. HARTMAN 1943 Influence of adrenal preparations on fish melanophores. Endocrinology. 32 (2): 145–148.

TRUEX, R. C., AND L. J. WARSHAW 1942 The incidence and size of the moderator band in man and in mammals. Anat. Rec., 82 (3): 361–372.

VIII. HAIR, SKIN AND MUSCLES

Hair

ALBRIGHT, F., P. H. SMITH AND R. FRASER 1942 A syndrome characterized by primary ovarian insufficiency and decreased stature; report of 11 cases with digression on hormonal control of axillary and pubic hair. Am. J. Med. Sci. 204: 625–648.

BERNSTEIN, M. M., AND B. S. BURKS 1942 Incidence and mendelian transmission of mid-digital hair in man. J. Hered. 33: 45–53.

BUTCHER, E. O. 1942 The effect of location on the quality of the hair and skin in the white rat. Anat. Rec. 83 (4): 503–510.

COLIN, E. C. 1943 Hair direction in mammals; embryogenesis of hair follicles in the guinea pig. J. Morph. 72 (2): 191–224.

FENNER, F. 1942 The mid-dorsal hair whorl in an Australian of European ancestry. J. Anat. 76: 356–358.

FORBES, T. R. 1942 Sex hormones and hair changes in rats. Endocrinology 30 (3): 465–468.

HAMILTON, J. B. 1942 Male hormone stimulation is prerequisite and an incitant in common baldness. Am. J. Anat. 71 (3): 451–480.

KALISS, NATHAN 1942 The morphogenesis of pigment in the hair follicles of the house mouse. J. Morph. 70 (2): 209–220.

SEIBERT, H. C., AND M. STEGGERDA 1942 The size and shape of human head hair along its shaft. J. Hered. 33 (8): 302–304. (Biol. Abst. Sec. A 17 (1) 1943).

TROTTER, MILDRED 1943 Hair from Paracas Indian mummies. Am. J. Phys. Anthrop., n.s., 1 (1): 69–76.

Skin

BRIDGES, B. C. 1942 Practical fingerprinting. New York and London (Funk and Wagnalls Co.)

CROMWELL, H., AND D. C. RIFE 1942 Dermatoglyphics in relation to functional handedness. Hum. Biol. 14 (4): 516–526.

MIDLO, CHARLES, AND HAROLD CUMMINS 1942 Palmar and plantar dermatoglyphics in primates. Am. Anat. Mem. 20: 1–198. (Biol. Abst. Sec. A 17 (4) 1943).

OHLER, E. A., AND H. CUMMINS 1942 Sexual differences in breadths of epidermal ridges on finger tips and palms. Am. J. Phys. Anthrop. 29 (3): 341–362.

RIFE, D. C. 1943 Genetic interrelationships of dermatoglyphics and functional handedness. Genetics, 28 (1): 41–48. (Biol. Abst. Sec. A 17 (5) 1943).

Muscles

BEATON, L. E., AND B. J. ANSON 1942 Variations in the origin of the m. trapezius. Anat. Rec. 83 (1): 41–46.

BUNNELL, S. 1942 Surgery of the intrinsic muscles of the hand other than those producing opposition of the thumb. J. Bone & Joint Surg. 24: 1–31.

ELIOT, T. S., ET AL. 1943 The number and size of muscle fibers in the rat soleus in relation to age, sex, and exercise. (Abst. from Suppl. Anat., Rec. 35 (3) March '43).

MAYER, L., AND B. B. GREENBURG 1942 Measurements of the strength of trunk muscles. J. Bone & Joint Surg. 24: 842–856.

REPORT OF THE RESEARCH COMMITTEE OF THE AMERICAN ORTHOPOEDIC ASSOCIATION 1942 A survey of end results on stabilization of the paralytic shoulder. J. Bone & Joint Surg. 24: 699–707.

ROMER, A. S. 1942 The development of tetrapod limb musculature — the thigh of Lacerta. J. Morph. 71 (2): 251–298.

SPERRY, R. W. 1942 Transplantation of motor nerves and muscles in the forelimb of the rat. J. Comp. Neur. 76 (2): 283–322.

STRAUS, W. L. 1942 The homologies of the forearm flexors; urodeles, lizards, mammals. Am. J. Anat. 70 (2): 281–316.

TERRY, R. J. 1942 Absence of superior gemellus muscle in American Whites and Negroes. Am. J. Phys. Anthrop. 29 (1): 47–56. (Biol. Abst. Sec. B 16 (7) 1942).

IX. HEREDITY

General references

ANONYMOUS 1942 Family history and longevity. Statist. Bull. Metrop. Life Ins. Co. 23 (2): 9–10. (Biol. Abst. Sec. A 17 (1) 1943).

AREY, L. B. 1942 Developmental Anatomy. Phila. (W. B. Saunders Co.)

CASTLE, W. E. 1942 Dog crosses and human crosses. Rev. of C. R. Stockard, "The genetic and endocrine basis for differences in form and behavior." J. Hered. 33 (7): 249–252.

COTTERMAN, C. W. 1942 The biometrical approach in human genetics. Am. Nat. 76 (763): 144–155. (Biol. Abst. Sec. A 17 (1) 1943).

DUDLEY, F. C., AND WILLIAM ALLAN 1942 Mating customs in North Carolina, 1750–1900. J. Hered. 33 (9): 331–332.

DUNN, L. C., AND S. GLUECKSOHN-SCHOENHEIMER 1942 Stub, a new mutation in the house mouse. J. Hered. 33 (6): 235–239.

ELLINGER, T. U. H. 1942 On the breeding of Aryans and other genetic problems of war-time Germany. J. Hered. 33 (4): 141–143.

FINNEY, D. J. 1942 The detection of linkage. IV. Lack of parental records and the use of empirical estimates of information. J. Hered. 33 (4): 157–160. (Biol. Abst. Sec. A 17 (1) 1943).

FORD, E. B. 1942 Genetics for medical students. London (Methuen and Co., Ltd.) (Biol. Abst. Sec. A 17 (3) 1943).

GARDNER, IVA C., AND H. H. NEWMAN 1942 Studies of quadruplets. IV. The Badgett quadruplets. J. Hered. 33 (10): 345–350. (Biol. Abst. Sec. A 17 (4) 1943).

——— 1943 Studies of quadruplets. V. The Kaspar quadruplets. J. Hered. 34 (1): 27–32. (Biol. Abst. Sec. A 17 (6) 1943).

GATES, R. R. 1942 Symbols for human genes. Science, 95 (2453): 17–18. (Biol. Abst. Sec. A 17 (1) 1943).

——— 1942 Heredity and environment in human genetics. Current Sci. 11 (3) Suppl: 127–134. (Biol. Abst. Sec. A 17 (3) 1943).

GOWEN, J. W. 1942 On the sex ratio in cattle. J. Hered. 33 (8): 299–301.

GREULACH, V. A. 1942 Lay opinions about eugenics. J. Hered. 33 (11): 416.

GRUENWALD, PETER 1942 Early human twins with peculiar relations to each other and the chorion. Anat. Rec. 83 (2): 267–280.

GRÜNEBERG, H. 1943 Genetics of the mouse. New York (Cambridge U. Press and Macmillan). (J. Hered. 34 (6): 172–174, 1943).

HALDANE, J. B. S. 1942 New paths in genetics. New York (Harper and Brothers). (Biol. Abst. Sec. A 16 (8) 1942).

HAZEL, L. N., AND J. L. LUSH 1942 The efficiency of three methods of selection. J. Hered. 33 (11): 393–399.

HUESTIS, R. R., AND VICTOR PIESTRAK 1942 Aberrent ratios in Peromyscus. J. Hered. 33 (8): 289–291.

LEWIS, J. H. 1942 The biology of the Negro. Chicago (Univ. of Chicago Press).

NEWMAN, H. H., AND I. C. GARDNER 1942 Types and frequencies of quadruplets. Studies of quadruplets. III. J. Hered. 33 (9): 311–314. (Biol. Abst. Sec. A 17 (4) 1943).

PENROSE, L. S. 1942 Future possibilities in human genetics. Am. Nat. 76 (763): 165–170. (Biol. Abst. Sec. A 17 (1) 1943).

SCHULTZ, J. 1943 Physiological aspects of genetics. Ann. Rev. Physiol. 5: 35–62.

SCOTT, G. D. 1942 Heredity, food, and environment in the nutrition of infants and children. Boston (Chapman and Grimes, Inc.).

SEVERINGHAUS, A. E. 1942 Sex chromosomes in a human intersex. Am. J. Anat. 70 (1): 73–94.

SNYDER, L. H. 1942 The mutant gene in man. Am. Nat. 76 (763): 129–143. (Biol. Abst. Sec. A 17 (1) 1943).

STEPHENS, F. E., AND R. B. THOMPSON 1943 The case of Millan and George, identical twins, reared apart. J. Hered. 34 (4): 109–114.

STRANDSKOV, H. H. 1942 The genetics of human populations. Am. Nat. 76 (763): 156–164. (Biol. Abst. Sec. A 17 (1) 1943).

——— 1942 Physiological aspects of genetics. Ann. Rev. Physiol. 4: 49–66.

THOMPSON, J. C., V. C. COBB, C. E. KEELER AND M. DNYTRYE 1943 Genetics of the Burmese cat. J. Hered. 34 (4): 119–123.

WADDINGTON, C. H. 1942 Canalization of development and the inheritance of acquired characters. Nature 150 (3811): 563–565. (Biol. Abst. Sec. A 17 (6) 1943).

WHITNEY, DAVID D. 1942 Family treasures. A study of the inheritance of normal characteristics in man. Lancaster (Jaques Cattell Press). (Biol. Abst. Sec. A 17 (5) 1943).

ZUBILIAGA, A., AND L. Z. GONZALES 1942 Primera communicacion sobre los cuadruples Mendoza. Arch. Venezuelanos, Puericul. y Pediat. 4 (12): 641–647. (Biol. Abst. Sec. B 17 (5) 1943).

Heredity in head and face (including teeth) and in the skeleton

ANSPACH, E., AND R. C. HUEPEL 1942 Familial cleidocranial dysostosis. A preosseous and dentinal dystrophy. Am. J. Dis. Child. 58 (4): 786–798.

ASMUNDSON, V. S. 1942 An inherited micromelia in the domestic fowl. J. Hered. 33 (9): 328–330.

BEERS, C. V., AND L. A. CLARK 1942 Tumors and short-toe. A dihybrid pedigree. A family history showing the inheritance of hemangioma and metatarsus atavicus. J. Hered. 33 (10): 366–368. (Biol. Abst. Sec. A 17 (4) 1943).

BLATTNER, R. J., ET AL. 1942 Osteogenesis imperfecta and odontogenesis imperfecta (hereditary opalescent dentin) (Abst.) J. Dent. Res. 21: 325–326.

BRODIE, A. G., AND B. G. SARNAT 1942 Complete anodontia. A serial roentgenographic cephalometric appraisal. (Abst.) J. Dent. Res. 21: 329.

CALLAN, ROSEMARY 1942 Polydactyly in a Negro family. J. Hered. 33 (6): 229–232. (Biol. Abst. Sec. A 17 (1) 1943).

COHEN, J. T., ET AL. 1942 Dental studies of triplets. I. & II. J. Dent. Res. 21 (2): 233–240; 21 (3): 413–420.

FORD, NORMA, AND A. D. MASON 1943 Heredity as an aetiological factor in malocclusion. As shown by a study of the Dionne Quintuplets. J. Hered. 34 (2): 57–64.

FOSTER, L. W. 1942 Dental condition in white and Indian children in northern Wisconsin. J. Am. Dent. Assoc. 29 (19): 2251–2255.

GOULD, ERNEST A. 1942 Three generations of exostoses of the heel. J. Hered. 33 (6): 228. (Biol. Abst. Sec. A 17 (1) 1943).

HART, V. L. 1942 Primary genetic dysplasia of the hip with and without classical dislocation. J. Bone & Joint Surg. 24: 753–771.

HOLLANDER, W. F., AND W. M. LEVI 1942 Polydactyly, a sub-lethal character in the pigeon. J. Hered. 33 (11): 385–391.

HUGHES, B. O. 1942 Heredity as a factor in cranial and facial development. Am. J. Orthodont. & Oral Surg. 28: 357–360.

KILLINGSWORTH, W. P., AND R. ENGLEDOW 1942 Congenital absence of the four extremities. Am. J. Dis. Child. 63 (5): 914–918.

MCCAULEY, H. B. 1942 Roentgen-ray absorption study of hereditary opalescent dentin. J. Dent. Res. 21 (1): 107–114.

MACDOWELL, E. C., J. S. POTTER, T. LAANES AND E. N. WARD 1942 The manifold effects of the screw-tail mouse mutation. J. Hered. 33 (12): 439–449.

MEAD, S. W., P. W. GREGORY AND W. M. REGAN 1942 Proportionate dwarfism in Jersey cows. J. Hered. 33 (11): 411–416. (Biol. Abst. Sec. A 17 (6) 1943).

MOORE, G. R., AND B. O. HUGHES 1942 Familial factors in diagnosis, treatment and prognosis of dento-facial disturbances. Am. J. Orthodont. and Oral Surg. 28: 603–639.

ODIORNE, J. M. 1943 Polydactylism in related New England families. J. Hered. 34 (2): 45–55.

RADOS, ANDREW 1942 Marfan's syndrome (arachnodactyly coupled with dislocation of the lens). Arch. Ophthalmol. 27 (3): 477–538. (Biol. Abst. Sec. A 16 (8) 1942).

STAUFFER, J., AND I. SIMMONS 1942 Hyperkeratosis of the large toenails and sebaceous cysts. J. Hered. 33 (8): 285–288.

STEGGERDA, MORRIS 1942 Inheritance of short metatarsals. J. Hered. 33 (6): 233–234. (Biol. Abst. Sec. A 17 (1) 1943).

THOMA, K., M. C. SOSMAN AND G. A. BENNET 1943 Unusual case of hereditary fibrous osteodysplasia (fragilitas ossium) with replacement of dentine by osteocementum. Am. J. Orthondont. 29: 1–30.

VANZANT, B. I., AND F. R. VANZANT 1942 Hereditary deforming chrondrodysplasia. J. Am. Med. Assoc. 119: 786–790.

WATERS, N. F., AND J. H. BYWATERS 1943 A lethal embryonic wing mutation in the domestic fowl. J. Hered. 34 (7): 213–217.

WEINMANN, J. P., AND J. F. SVOBODA 1942 Hereditary amelogenesis imperfecta (Abst.) J. Dent. Res. 21: 306.

Heredity in skin, hair, eye

ALLEN, MARY 1942 Primary hereditary nystagmus. J. Hered. 33 (12): 454–456. (Biol. Abst. Sec. A 17 (6) 1943).

ANONYMOUS 1942 Note: Albinism in the Virginia deer. J. Hered. 33 (8): 274 and 284.

BERNSTEIN, M. M., AND B. S. BURKS 1942 The incidence and Mendelian transmission of mid-digital hair in man. J. Hered. 33 (2): 45–53. (Biol. Abst. Sec. A 16 (8) 1942).

BILLINGS, M. L. 1942 Nystagmus through four generations. J. Hered. 33 (12): 457. (Biol. Abst. Sec. A 17 (6) 1943).

BRIGGS, L. C., AND NATHAN KALISS 1942 Coat color inheritance in Bull Terriers. J. Hered. 33 (6): 223–228.

CARTLEDGE, J. L., AND V. W. MYERS 1943 Inherited foot-blistering in an American family. J. Hered. 34 (1): 24.

CROMWELL, H., AND D. C. RIFE 1942 Dermatoglyphics in relation to functional handedness. Hum. Biol. 14 (4): 516–526.

FLACH, F. 1942 A familial study in myopia. J. Hered. 33 (12): 456–457. (Biol. Abst. Sec. A 17 (6) 1943).

GREGORY, P. W., S. W. MEAD AND W. M. REGAN 1943 A congenital hereditary eye defect of cattle. J. Hered. 34 (4): 125–128.

JONES, H. E., AND D. H. MORGAN 1942 Twin similarities in eye movement patterns. J. Hered. 33 (5): 167–172. (Biol. Abst. Sec. A 17 (1) 1943).

NEEL, J. V. 1943 Concerning the inheritance of red hair. J. Hered. 34 (3): 93–96.

PIPKIN, A. C., AND S. B. PIPKIN 1942 Albinism in Negroes. J. Hered. 33 (12): 419–427. (Biol. Abst. Sec. A 17 (6) 1943).

RIDDELL, W. J. B. 1941–42 Studies in the classification of eye colour. Ann. Eugenics, 11 (3): 245–259. (Biol. Abst. Sec. A 17 (3) 1943).

RIFE, D. C. 1943 Handedness and dermatoglyphics in twins. Hum. Biol. 15 (1): 46–54.

RIFE, D. C., AND H. CUMMINS 1943 Dermatoglyphics and "Mirror Imaging". Hum. Biol. 15 (1): 55–64.

SEIBERT, H. C., AND MORRIS STEGGERDA 1942 The size and shape of human head hair along its shaft. J. Hered. 33 (8): 302–304.

SMITH, S. E., AND B. F. BARRENTINE 1943 Hereditary cataract, a new dominant gene in the rat. J. Hered. 34 (1): 8–10.

STADLER, H., AND C. H. BLACKSTONE 1942 Hereditary ectodermal dysplasia of the anhydrotic type. J. Pediat. 21: 229–237.

STAUFFER, J., AND I. SIMMONS 1942 Hyperkeratosis of the large toenails and seabaceous cysts. J. Hered. 33 (8): 285–288. (Biol. Abst. Sec. A 17 (1) 1943).

SURRARRER, T. C. 1943 Bulldog and hairless calves. J. Hered. 34 (6): 175–178.

Heredity in blood and blood-group

BEERS, C. V., AND W. G. SHULL 1943 Hemophilia, heredity and treatment. (Abst.) Genetics, 28 (1): 70.

CANDELA, P. B. 1942 The introduction of blood-group B into Europe. Hum. Biol. 14 (4): 413–443.

HYMAN-PARKER, H. S. 1942 The development of the agglutinogens M and N in the newborn infants. J. Immunol. 43 (1): 1–11.

KALISS, N., AND M. D. SCHWEITZER 1943 Hereditary hemorrhage diathesis — a case of partial sex-linkage in man (Abst.) Genetics, 28 (1): 78–79.

LANDSTEINER, KARL, A. S. WIENER AND G. A. MATSON 1942 Distribution of the Rh factor in American Indians. J. Exper. Med. 76 (1): 73–78.

LEVINE, P. 1942 On human anti-Rh sera and their importance in racial studies. Science, 96 (2498): 452–453.

———— 1943 Serological factors as possible causes in spontaneous abortions. J. Hered. 34 (3): 71–79.

MORRISON, M., A. A. SAMWICK AND E. LANDSBERG 1942 Sickle cell anemia in the White race: report of two cases with diagnosis by splenic puncture. Am. J. Dis. Child. 64 (5): 881–887.

ROBERTS, J. A. FRASER 1941–1942 Blood group frequencies in North Wales. Ann. Eugenics. 11 (3): 260–271.

WIENER, A. S. 1942 The Rh factor and racial origins. Science, 96 (2496): 407–408.

WIENER, A. S., AND CARL LANDSTEINER 1942 Heredity of Rh types. Proc. Soc. Experim. Biol. and Med. 53: 167.

Heredity in mental characters

ALLAN, W., AND S. L. HALPERIN 1942 The inheritance of certain varieties of mental defect. N. Carolina Med. J. 3 (7): 1–8.

FARD, NORMA, AND S. FRUMKIN 1942 Monozygosity in mongoloid twins. Am. J. Dis. Child. 63: 847–858.

HANKINS, F. H. 1942 Is our innate national intelligence declining? Am. J. Ment. Def. 47 (1): 25–31.

JERVIS, G. A. 1942 Familial mental deficiency akin to amaurotic idiocy and gargoylism. Arch. Neurol. and Psychiat. 47: 943–961.

——— 1943 Mongolism in twins. Am. J. Ment. Def. 47 (4): 364–369.

KLINGER, L. H., AND S. A. BLAUNER 1942 Amaurotic idiocy in identical twins. Am. J. Dis. Child. 64 (3): 492-496.

LENNOX, W. G. 1942 Mental defect in epilepsy and the influence of heredity. Am. J. Psychiat. 98: 733–739.

LIPNITZKY, S. J., AND BENJAMIN BOSHES 1942 A possible paternal factor in the etiology of mongolism. J. Hered. 33 (4): 155–156. (Biol. Abst. Sec. A 17 (1) 1943).

PENROSE, L. S. 1942 Auxiliary genes for determining sex as contributory causes of mental illness. J. Mental Sci. 88: 308–316.

——— 1942 Mental disease and natural selection. Am. J. Ment. Def. Vol. 46 (4): 453–458, April.

ROE, ANNE AND DAVID SHAKOW 1942 Intelligence in mental disorders. Ann. New York Acad. Sci. 42 (4): 361–490.

SCHWEITZER, M. D. 1942 The challenge of mental deficiency to genetics. Am. J. Ment. Def. (3): 295–297.

WAGGONER, R. W., K. LOWENBERG-SCHARENBERG AND MARGARET SCHILLING 1942 Agenesis of the white matter with idiocy. Am. J. Ment. Def. 47: 20–24.

Heredity in disease and pathology

ADDAIR, JOHN AND L. H. SNYDER 1942 Evidence for an autosomal recessive gene for susceptibility to paralytic poliomyelitis. Studies in human inheritance. XXI. J. Hered. 33 (9): 307–309. (Biol. Abst. Sec. A 17 (4) 1943).

ANDREWS, J. C., AND R. E. BROOKS 1942 A study of cystinuric family. J. Urol. 47: 171–173.

ANONYMOUS 1942 Heredity and environment in the causation of leprosy. J. Hered. 33 (6): 239–240.

BEERS, C. V., AND L. A. CLARK 1942 Tumors and short-toe. A dihybrid pedigree. A family history showing the inheritance of hemangioma and metatarsus atavicus. J. Hered. 33 (10): 366–368.

BLOOM, D., S. R. KAUFMAN AND R. A. STEVENS 1942 Hereditary xanthomatosis. Familial incidence of xanthoma tuberosum associated with hypercholesteremia and cardiovascular involvement. Arch. Derm. and Syph. 45 (1): 1–17. (Biol. Abst. Sec. A 16 (8) 1942).

CARTLEDGE, J. L., AND F. E. HANCOCK 1942 Inherited breech presentation. J. Hered. 33 (11): 409–410. (Biol. Abst. Sec. A (6) 1943).

Cartledge, J. L., and V. W. Myers 1943 Inherited foot-blistering in an American family. J. Hered. 34 (1): 24. (Biol. Abst. Sec. A 17 (6) 1943).

Chumlea, B. J. 1942 A pedigree of otosclerosis. J. Hered. 33 (3): 98–99. (Biol. Abst. Sec. A 17 (1) 1943).

Criep, L. H. 1942 Allergy in identical twins. Report of seven pairs of twins. J. of Allergy, 13: 591–597.

Cumley, R. W., and M. R. Jewin 1942 Genetic segregation of antigens. III. Pictorial representation of the antigens of the blood corpuscles of two dove species and their hybrids, and the segregation of species — specific substances in back-cross generations. J. Hered. 33 (10): 357–365.

Davison, W. C. 1942 Heredity and genetics. J. Pediat. 21: 246–250.

Evans, Philip 1942 A hereditary tendency to hernia. Lancet 242 (6184): 293. (Biol. Abst. Sec. A 17 (1) 1943).

Falls, H. F. 1942 Familial incidence of retinoblastoma, with genealogic chart. Am. J. Ophthal. 25: 42–47.

Fowler, E. P. 1942 Studies of deafness in twins. Otosclerosis in identical twins. Three case histories. Laryngoscope, 52 (9): 718–731. (Biol. Abst. Sec. A 17 (6) 1943).

Gould, E. A. 1942 Three generations of exostoses of the heel. J. Hered. 33 (6): 228.

Green, E. L., and M. C. Green 1942 The development of three manifestations of the short ear gene in the mouse. J. Morph. 70 (1): 1–20.

Haldane, J. B. S., and R. Poole 1942 A new pedigree of recurrent bullous eruption of the feet. J. Hered. 33 (1): 17–18.

Halperin, S. L., and G. M. Curtis 1942 Anhidrotic ectodermal dysplasia associated with mental deficiency. Am. J. Ment. Def. 46 (4): 459–463.

——— 1942 The genetics of gargoylism. Am. J. Ment. Def. 46 (3): 288–291.

Henley, Austin F. 1942 A case of osteopsathrosis with the genealogical tree of the family. Brit. Med. J. 1942 (4235): 326–327. (Biol. Abst. Sec. A 17 (1) 1943).

Herndon, C. N., and F. C. Dudley 1943 The inheritance of von Recklinghausen's neurofibromatosis. J. Bowman Gray School of Med. 1 (3): 69–74.

Hughson, W., A. Ciocco and C. E. Palmer 1942 Studies on pupils of the Pennsylvania School for the deaf. IV. Mechanism of inheritance of deafness. Arch. Otolaryngol. 35: 871–882.

Kean, B. H. 1942 Complete transposition of the viscera in both of one-egg twins. J. Hered. 33 (6): 217–221.

Ketchum, Dorsey 1942 Congenital cataract. W. Virginia. Med. J. 38 (7): 247–249.

Lubin, A. J., O. Marburg and K. Tamaki 1943 Familial type of paralysis in infants and its relationship to other heredofamilial disorders. Arch. Neurol. and Psychiat. 49 (1): 27–42. (Biol. Abst. Sec. B 17 (6) 1943).

McNutt, C. W., and P. B. Sawin 1943 Hereditary variations in the vena cava inferior of the rabbit. Am. J. Anat. 72 (2): 259–290.

Martens, E. J., and H. V. Meredith 1942 Illness history and physical growth. I. Correlation in junior primary children followed from fall to spring. Am. J. Dis. Child. 64 (4): 618–630.

Montagu, M. F. Ashley 1942 A case of familial inheritance of oblique inguinal hernia. J. Hered. 33 (10): 355–356. (Biol. Abst. Sec. A 17 (4) 1943).

Oliver, C. P., and R. C. Gray 1942 The use of genetic information in the control of hereditary ataxia in a human kinship. (Abst.) Genetics, 27 (1): 159.

Pfaff, W. 1942 Das Erbe als Formgestalter der Tuberkulose. Deutsch. med. Wochenschr. 68 (8): 201–202. (Biol. Abst. Sec. A 17 (6) 1943).

Pipkin, Alan, and S. B. Pipkin 1942 Albinism in Negroes. J. Hered. 33 (12): 419–427.

Smyth, C. J., and R. H. Freyberg 1942 A study of the hereditary nature of gout; a report of two families. Ann. Internal Med. 16 (1): 46–56. (Biol. Abst. Sec. A 17 (1) 1943).

Snyder, L. H., and D. M. Palmer 1943 An idiopathic convulsive disorder with deterioration. J. Hered. 34 (7): 207–212.

Stellar, L. I. 1942 Hereditary telangiectasis. Report of a case. New England J. Med. 226 (9): 336–338.

Williams, Howard 1942 The surgical treatment of congenital pyloric stenosis of infancy: a review of 400 cases. Med. J. Australia, 1: 303–311.

Willoughby, D. P. 1942 An extraordinary case of obesity and a review of some lesser cases. Hum. Biol. 14 (2): 166–177.

Wolff, Georg, and Antonio Ciocco 1942 Infection, social environment and heredity in tuberculosis. Am. Rev. Tuberc. 46: 142–163.

X. GROWTH

General References

Aldrich, C. A. 1942 How to get parents to think in developmental terms. J. Pediat. 20: 272–275.

Ames, L. B. 1942 Supine leg and foot postures in the human infant in the first year of life. J. Genet. Psychol. 61: 87–107.

Avery, G. S. 1942 Growth. Ann. Rev. Physiol. 4: 115–138.

Breckenridge, M. E., and E. L. Vincent 1943 Child Development: Physical and psychological growth through the school years. Philadelphia (W. B. Saunders Co.), pp. ix–592 (1–115, 229–273).

Bruch, Hilde 1942 The grid for evaluating physical fitness (Wetzel). Application to children with abnormal bodily dimensions. J. Am. Med. Assoc. 118 (15): 1289–1293. (Biol. Abst. (Sec. B 17 (6) 1943).

Clayton, M. 1942 A study of the McCloy method for determining normal weight. Child Develop. 13 (3): 215–226. (Biol. Abst. Sec. B 17 (3) 1943).

Cole, Luella 1942 Bodily growth. In "Psychology of Adolescence," New York (Farrar and Rinehart, Inc.), pp. xvii–600 (17–61).

COUNT, E. W. 1943 Growth patterns of the human physique: An approach to kinetic anthropometry: Part I. Hum. Biol. 15: 1–32.

EDWARDS, T. I. 1942 Computing scales for calculating percentage deviation from average weight. Science, 95, 50–51. (Nut. Abst. Rev. 12 (3) 1943).

GESELL, ARNOLD, L. E. HOLT, C. S. AMATRUDA, W. M. PHELPS AND C. A. ALDRICH 1942 Panel discussion on clinical aspects of growth and development. J. Pediat. 20: 259–278.

GORDON, I. 1942 Some social aspects of infant feeding. Arch. Dis. Childhood. 17, 139–146. (Nut. Abst. Rev. 12 (3) 1943).

GRUENBERG, H. 1943 The develpoment of some external features in mouse embryos. J. Hered. 34 (3): 89–92.

HUGGINS, S. E., AND D. H. THOMPSON 1942 Relative growth in several species of fresh-water gar. Growth 6 (2): 163–171. (Biol. Abst. Sec. B 17 (1) 1943).

KAVANAGH, A. J., AND O. W. RICHARDS 1942 Mathematical analysis of the relative growth of organism. Rochester Acad. Sci. 8 (4): 150–174. (Biol. Abts. Sec. B 17 (1) 1943).

KELLY, H. J., H. J. SOUDERS, A. T. JOHNSTON, L. E. BOUND, H. A. HUNSCHER AND I. G. MACY 1943 Daily decreases in the body total and stem lengths of normal children. Hum. Biol. 15 (1): 65–72.

KROGMAN, W. M. 1943 Human growth: I. Principles of human growth, II. The measurement of the human body, III. Factors affecting human growth. Ciba Symposia, 5: 1458–1485.

KUGELMASS, I. N. 1942 Superior children through modern nutrition. How to perfect the growth and development of your children from birth to maturity. New York (E. P. Dutton and Co.)

LUMER, H., B. G. ANDERSON AND A. H. HERSH 1942 On the significance of the constant b in the law of allometry $y = bx^a$. Am. Nat. 76 (765): 364–375. (Biol. Abst. Sec. B 17 (1) 1943).

MECHEM, E. 1943 Affectivity and growth in children. Child Develop. 14 (2): 91–115.

MEREDITH, H. V. 1942 Critical review of "Predicting the Child's Development" by W. F. Dearborn and J. W. M. Rothney. Psychol. Bull., 39: 245–249, 254.

MEREDITH, H. V. AND J. L. GOODMAN 1941 A comparison of routine hospital records of birth stature with measurements of birth stature obtained for longitudinal research. Child Develop. 12 (2): 175–181. (Biol. Abst. Sec. B 17 (2) 1943).

MILLS, C. A. 1942 Climate makes the man. New York (Harper and Brothers), pp. vi–320 (55–67, 299–306).

NAGGE, J. W. 1942 The physical growth of the child, in "Psychology of the child: Mental and physical growth." New York (The Ronald Press Co.), pp. xiii–530 (187–223, see also 58–61).

PEOPLE'S LEAGUE OF HEALTH 1942 Nutrition of expectant and nursing mothers. Interim report of the People's League of Health. Lancet, 243, 10–12; Brit. Med. J., ii, 77–78. (Nutr. Abst. Rev. 12 (3) 1943).

PRYOR, H. B. 1942 Width-weight tables (revised) Am. J. Dis. Child, 61 (2): 300–304.

——— 1943 As the child grows. New York (Silver Burdett Co.), pp. xvi–400.

ROBINOW, M. 1942 The variability of weight and height increments from birth to six years. Child Develop. 13 (2): 159–164. (Biol. Abst. Sec. B 17 (2) 1943; Nut. Abst. Rev. 12 (3), 1943).

ROBINOW, MEINHARD, V. L. LEONARD AND M. ANDERSON 1943 A new approach to the quantitative analysis of children's posture. J. Pediat. 22: 655–663.

SCAMMON, R. E. 1942 Developmental anatomy, in "Morris' Human Anatomy," edited by J. Parsons Schaeffer, tenth edition. Philadelphia (The Blakiston Co.), 1635 pp. (9–52).

SCHONFELD, W. A. 1943 Primary and secondary sexual characteristics: Study of their development in males from birth through maturity, with biometric study of penis and testes. Am. J. Dis. Child., 65: 535–549.

SCHWARTZMAN, JOSEPH 1942 Abnormalities of adolescence. J. Pediat. 21 (1): 93–102, (Biol. Abst. Sec. B 17 (3), 1943).

SELTZER, C. C., AND L. BROUHA 1943 The masculine component and physical fitness. Am. J. Phys. Anthrop., n.s. 1: 95–108.

SHOCK, N. W., AND M. F. MORALES 1942 A fundamental form for the differential equation of colonial and organismal growth. Bull. Math. Biophys. 4 (2): 63–71. (Biol. Abst. Sec. B 17 (6) 1943).

SMITH, R. M. 1942 Children in war time. Am. J. Dis. Child. 64 (3): 497–504.

STEGGERDA, M., AND C. SHAFFER 1942 Anthropology and human genetics, in Carnegie Institution of Washington Year Book No. 41 (see section on Child Development, p. 211–213).

STRANDSKOV, H. H. 1942 On the variance of human live birth sex ratios. Hum. Biol. 14 (1): 85–94.

THOMPSON, D. W. 1942 On growth and form. Rev. ed. Cambridge (University Press) and New York (Macmillan Co.). (Biol. Abst. Sec. B 17 (2) 1943).

THELANDER, H. E. AND M. L. FITZHUGH 1942 Posture habits in infancy affecting foot and leg alignments. J. Pediat., 21: 306–314.

WETZEL, N. C. 1943 Assessing the physical condition of children: I. Case demonstration of failing growth and the determination of "par" by the grid method; II. Simple malnutrition: A problem of failing growth and development; III. The components of physical status and physical progress and their evaluation. J. Pediat., 22: 82–110, 208–225, 329–361.

WOLFF, GEORG 1942 A study of height in white children from 1937 to 1940 and a comparison of different height-weight indices. Child Develop. 13 (1): 65–77. (Biol. Abst. Sec. B 16 (10) 1942).

Skeletal growth and ossification

ANSON, B. J., AND E. W. CAULDWELL 1942 The developmental anatomy of the human stapes. An. Otol., Rhinol. and Laryngol. 51: 891–904.

BARBER, C. G. 1942 Osteochondrosis deformans tibiae: Nonrachitic bow leg in children. Am. J. Dis. Child. 64: 831–842.

BAYLEY, NANCY 1943 Size and body build of adolescents in relation to rate of skeletal maturing. Child Develop. 14: 47–90.

———— 1943 Skeletal maturing in adolescence as a basis for determining percentage of completed growth. Child Develop. 14: 1–46.

BLOOM, M. A., F. C. MCLEAN AND WILLIAM BLOOM 1942 Calcification and ossification. The formation of medullary bone in male and castrate pigeons under the influence of sex hormones. Anat. Rec. 83 (1): 99–120.

BRAILSFORD, J. F. 1943 Variation in the ossification of the bones of the hand. J. Anat. 77: 170–175.

BUEHL, C. C. AND I. S. PYLE 1942 The use of age at first appearance of three ossification centers in determining the skeletal status of children. J. Pediat. 21: 335–342.

CAULDWELL, E. W., AND B. J. ANSON 1942 Stapes, fissula ante fenestram and associated structures in man: III. From embryos 6.7 to 50 mm. in length. Arch. Otolaryngol. 36: 891–925.

CHANDLER, F. A. 1942 Children's feet: normal and presenting common abnormalities. Am. J. Dis. Child. 63 (6): 1136–1146.

CHORNOCK, C. S., N. B. GUERRANT AND R. A. DUTCHER 1942 Effect of manganese on calcification in the growing rat. J. Nut. 23 (5): 445–458.

FLECKER, H. 1942 Time of appearance and fusion of ossification centers as observed by roentgenographic methods. Am. J. Roentgenol. and Rad. Therapy, 47: 97–159.

FOLLIS, R. H., D. JACKSON AND W. H. CARNES 1942 Skeletal changes associated with erythroblastosis foetalis. J. Pediat. 21: 80–92.

GOODMAN, JACK L. 1942 Changes in size and contour of thorax during first postnatal week. Am. J. Dis. Child. 64 (4): 674–679. (Biol. Abst. Sec. B 17 (4) 1943).

HRDLIČKA, ALES 1942 The juvenile scapula: Further observations. Am. J. Phys. Anthrop. 29: 287–310.

KAPLAN, J. A. ET AL. 1942 Traumatic bilateral separation of the lower femoral epiphyses. J. Bone & Joint Surg. 24: 200–201.

KILLINGSWORTH, W. P. AND R. ENGLEDOW 1942 Congenital absence of the four extremities. Am. J. Dis. Child. 63: 914–918.

MARESH, M. M. 1943 Growth of major long bones in healthy children: a preliminary report on successive roentgenograms of the extremities from early infancy to 12 yrs. of age. Am. J. Dis. Child. 66: 227–257.

MCLEAN, F. C. 1943 Physiology of bone. Ann. Rev. Physiol. 5: 79–104.

MILCH, H. 1942 Epiphyseal pseudarthrosis. J. Bone & Joint Surg. 24: 653–662.

MORTON, D. G. 1942 Observations of the development of pelvic conformation. Am. J. Obstet. and Gynecol. 44: 799–819.

NOYES, F. B. 1942 Histology of bone related to orthodontic treatment. Am. J. Orthodont. & Oral Surg. 28: 760–769.

O'DONOGHUE, W., AND L. S. SELL 1942 Persistent olecranon epiphyses in adults. J. Bone & Joint Surg. 24: 677–680.

PYLE, IDELL, AND L. W. SONTAG 1943 Variability in onset of ossification in epiphyses and short bones of the extremities. Am. J. Roentgenol. and Rad. Therapy, 49: 795–798.

ROBINOW, M. 1942 Appearance of ossification centers: Groupings obtained from factor analysis. Am. J. Dis. Child. 64 (2): 229–236. (Biol. Abst. Sec. B 17 (3) 1943).

RUSSIN, L. A., H. E. STADLER AND P. C. JEANS 1942 The bismuth lines of long bones in relation to linear growth. J. Pediat. 21: 211–213.

SILBERBURG, M., AND R. SILBERBURG 1942 Effects of endocrines on age changes in the epiphyseal and articular cartilages. Endocrinol. 31 (4) 410–418.

STUART, H. C. AND P. H. DWINELL 1942 The growth of bone, muscle and overlying tissues in children six to ten years of age as revealed by studies of roentgenograms of the leg area. Child Develop. 13: 195–213.

THELANDER, H. E., AND M. L. FITZHUGH 1942 Posture habits in infancy affecting foot and leg alignments. J. Pediat. 21: 306–314.

WASHBURN, S. L., AND S. R. DETWILER 1943 An experiment bearing on the problems of physical anthropology. Am. J. Phys. Anthrop., n.s. 1 (2): 171–190.

WASHBURN, S. L. 1943 The sequence of epiphysial union in Old World monkeys. Am. J. Anat. 72 (3): 339–360.

WATERMAN, A. J. 1943 Studies of normal development of the New Zealand white strain of rabbit. I. Oogenesis. II. External morphology of the embryo. Am. J. Anat. 72 (3): 473–515.

WEILER, H. G. 1942 Congenital absence of odontoid process of the axis with atlanto-axial dislocation. J. Bone & Joint Surg. 24: 161–165.

WILBAR, C. L. 1942 Bone development in preschool children. J. Pediat. 21: 504–509.

WISLOCKI, G. B. 1942 Studies on the growth of deer antlers. I. On the structure and histogenesis of the antlers of the Virginia deer (Odocoileus virginianus borealis). Am. J. Anat. 71 (3): 371–416.

Growth, in head, face, and teeth

APPEL, F. W., AND E. M. APPEL 1942 Intracranial variation in the weight of the human brain. Hum. Biol., 14: 48–68, 235–250.

ARSE, M., AND F. ARSE 1942 Roentgenographic study of craniofacial dysostosis; nonfamilial and non-hereditary cases. Am. J. Roentgenol. 47: 275–290.

ATKINSON, S. R. 1942 Symposium on treatment of dentofacial anomalies; anatomic factors guiding treatment. Am. J. Orthod. and Oral Surg. 28: 704–720.

BROADBENT, B. H. 1943 The influence of the third molars on the alignment of the teeth. Am. J. Orthodont. and Oral Surg. 29: 312–330.

BRODIE, G. 1942 On the growth of the jaws and the eruption of the teeth. Angle Orthodont. 12: 109–123.

BUCHANAN, A. R. 1942 Some concepts of the anatomy of the head and neck. Am. J. Orthodont. & Oral Surg. 28: 152–166.

CHASE, S. W. 1942 The early development of the human premaxilla. J. Am. Dent. Assoc. 29: 1991–2001.

CHEYNE, V. D. AND J. T. OBA 1943 Average weights of the permanent teeth, including the relative amounts of enamel to dentin and cemetum. J. Dent. Res. 22: 181–184.

COBB, W. M. 1943 The cranio-facial union and the maxillary tuber in mammals. Am. J. Anat. 72 (1): 39–112.

COHEN, J. T., C. P. OLIVER AND S. BERNICK 1942 Dental studies of triplets: I. Measurements of arch width and length; II. Arch form and pattern. J. Dent. Res. 21: 233–239, 413–420.

COUNT, E. W. 1942 A quantitative analysis of growth in certain human skull dimensions. Hum. Biol. 14: 141–165.

DOERING, C. R. AND M. F. ALLEN 1942 Data on eruption and caries of the deciduous teeth. Child Develop. 13: 113–129.

EASTLICK, K. A. 1942 Some growth problems of the orthodontist and the operative dentist. J. Am. Dent. Assoc. 29: 1357–1368.

EVANS, H. D. 1942 Experiences with roentgen pelvicephalometry. Hahnemann Monthly, 77: 565–579.

FRANKS, R. I. 1942 An orthodontic and prosthetic restoration in the mouth of the largest man in the world. Am. J. Orthodont. Oral Surg. 28: 580–583.

GALINDEG, L., R. CIAFARDO AND M. MALDONADO 1942 Craniofacial dysostosis in oligophrenia. Bol. d. Hosp. Melchor. Romero, 1: 3–8.

GESELL, A. 1942 Morphologies of mouth and mouth behavior. Am. J. Orthodont. Oral Surg. 28: 397–413.

GIBLIN, NORRIS AND ARMINE ALLEY 1942 A method of measuring bone growth in the skull. Anat. Rec. 83 (3): 381–388. (Biol. Abst. Sec. B 16 (10), 1942).

GLUCKSMAN, D. D. 1942 Localized vertical growth disturbance. J. Am. Dent. Assoc. 29: 184–186.

GROS, J. C. 1942 Meningioma with bone changes of face. Bol. Liga contra el Cancer. 17: 315–317.

HELLMAN, M. 1942 The optimum time for orthodontic treatment. J. Am. Dent. Assoc. 29: 622–639.

HERZBERG, F., AND R. HOLIC 1943 Anthropologic study of face height, (relation to dental attrition). Am. J. Orthodont. 29: 90–100.

HUGHES, B. O. 1942 Heredity as a factor in cranial and facial development. Am. J. Orthodont. and Oral Surg. 28: 357–360.

KENNEDY, R. L. J. AND J. D. CAMP 1942 Cranium changes in certain diseases in infants and children. Proc. Staff Meet. Mayo Clin. 17: 365–368.

LOUDET, O., L. GALINDEG AND R. CIAFARDO 1942 Typical craniafacial dystosis in phrenasthenia. Rev. de Psiquiat y Criminal, 7: 167–176.

MARKUS, M. B., S. D. GOSSMAN, N. H. EINHORN AND J. LERNER 1942 Facial development in hypopituitary dwarfism. Am. J. Orthodont. and Oral Surg. 28 (6): 334–350. (Biol. Abst. Sec. B 16 (9) 1942).

MARKUS, M. B. 1942 Divergence of facial growth and development of dentition. Am. J. Orthodont. and Oral Surg. 28 (12): 743–759. (Biol. Abst. Sec. B 17 (4) 1943).

MOLOY, H. C. 1942 Studies on head molding during labor. Am. J. Obs. and Gynecol. 44: 762–782.

OPPENHEIM, A. 1942 Human tissue response to orthodontic intervention of short and long duration. Am. J. Orthodont. & Oral Surg. 28: 263–301.

PENN, J., AND T. B. BERRY 1942 Hemiatrophy of the face. S. Afr. Dent. J. 16: 76–78. (Biol. Abst. Sec. B 16 (8) 1942).

ROGERS, A. P. 1942 Round table discussion on Orthodontics. J. Pediat. 21: 551–564.

ROBINOW, M., T. W. RICHARDS AND M. ANDERSON 1942 The eruption of deciduous teeth. Growth, 6: 127–133.

RUSHTON, M. A. 1942 A further case of unilateral hyperplasia of face and teeth. Am. J. Orthondont. and Oral Surg. 28 (1): 54–56. (Biol. Abst. Sec. B 16 (7) 1942).

SALZMANN, J. A. 1942 Influence of loss of permanent first molar on position of eruption of second premolar. J. Dent. Res. 21: 489–492.

SARNAT, B. G., AND W. E. HOOK 1942 Effects of hibernation on tooth development. Anat. Rec. 83 (4): 471–494.

SCHWEITZER, J. M. 1942 The vertical dimension. J. Am. Dent. Assoc. 29: 419–421.

SICHER, HENRY 1942 Tooth eruption: I. The axial movement of continuously growing teeth; II. Axial movement of teeth with limited growth. J. Dent. Res. 21: 201–210, 395–402.

SILLMAN, J. H. 1942 Malocclusion in the deciduous dentition; serial study from birth to five years. J. Am. Dent. Assoc. 28: 197–209.

SPIES, T. D. ET AL. 1942 Preliminary report on the effect of mechanical increase in the vertical dimension of the face in angular cheilosis. (Abst.) J. Dent. Res. 21: 305–306.

STRANGE, H. E. 1942 Why orthondontia cases fail. J. Am. Dent. Assoc. 29: 395–399.

STEADMAN, S. R. 1942 Résumé of the literature on root resorption. Angle Orthodont. 12: 28–38.

STEGGERDA, MORRIS AND T. J. HILL 1942 Eruption time of teeth among Whites, Negroes, and Indians. Am. J. Orthodont. and Oral Surg. 28: 361–370.

THELANDER, H. E. 1942 A five-year clinical study of factors affecting first dentition. J. Pediat. 20: 187–199.

WEINGART, M. A. 1942 The key ridge as a diagnostic aid in orthodontics. J. Am. Dent. Assoc. 29: 1583–1589.

WIERDA, J. L. 1942 An analysis of the relative growth-rates within the incisor tooth of the rat. Anat. Rec. 83 (4): 495–502.

WOODHALL, B. 1942 Oxycephaly. J. Pediat. 20: 585–595.

WRIGHT, W. H. 1942 Correlation between face form and tooth form in young adults. J. Am. Dent. Assoc. 29: 1388–1392.

Growth in the viscera

ANDREW, W. 1943 Senile changes in the pancreas of Wistar Institute rats and of man. (Abst. from Suppl. Anat. Rec. 35 (3) March '43).

BOUSLOG, J. S. 1942 The normal stomach and small intestines in the infant. Radiology, 39 (3): 253–260. (Biol. Abst. Sec. B 17 (3) 1943).

CURL, H. AND R. G. TROMLY 1943 Length of inguinal canal in fetus and newborn. (Abst. from Suppl. Anat. Rec. 35 (3) March '43).

ENGEL, STEFAN 1942 Growth of the lung in healthy and sick infants. Arch. Dis. Child. 17: 41–48.

HENDERSON, S. G. AND W. W. BRIANT 1942 The colon in the healthy newborn infant. Radiology, 39: 261–272.

JORDAN, H. E., AND J. E. KINDRED 1942 Textbook of Embryology, 4th Ed. New York (D. Appleton-Century Co.), pp. xiv–513.

KEEN, J. A. 1942 A note on the closure of the foramen ovale and the postnatal changes of the ventricles in the human heart. J. Anat. 77: 104–109.

KRAMER, T. C. 1942 The partitioning of the truncus and conus and the formation of the membranous portion of the interventricular septum in the human heart. Am. J. Anat. 71: 343–370.

POOL, W. E. AND C. E. PALMER 1942 Cardiometric studies on children IV A-V nodal escape and nodal rhythm in an otherwise normal subject. V Variable P–R interval and variations of heart sounds and ventricular systole. Child Develop. 13 (4) 253–268; 269–283.

POURCHET, MARÍA JULIA 1942 Contribucão ao estudo antropofisico da creança de côr (Bahia-Brasil). Actas de la I Sesión del XXVII Congr. Intern. Amer. (Mexico, 1939) tomo I, pp. 189–203.

Growth in racial groups

COBB, W. M. 1942 Physical anthropology of the American Negro. Am. J. Phys. Anthrop. 29: 113–223. (esp. pp. 166–168).

ITO, P. K. 1942 Comparative biometric study of physique of Japanese women born and reared under different environments. Hum. Biol. 13 (3): 279–351.

KEYFITZ, N., F. F. TISDALL AND J. H. EBBS 1942 A height and weight survey of Toronto elementary school children 1939. Ottawa, Canada: Department of Trade and Commerce, Dominion Bureau of Statistics, pp. 36.

MICHELSON, NICHOLAS 1943 Investigations in the physical development of Negroes. Am. J. Phys. Anthrop., n.s. 1: 191–213.

MILLS, C. A. 1942 Climatic effects on growth and development with particular reference to the effects of tropical residence. Am. J. Phys. Anthrop., n.s. 44: 1–13.

MUÑOZ, MANUEL 1942 El crecimiento somático del mestizo limeño. Bol. Inst. Psicoped. Nac. 1 (1): 55–64. (Biol. Abst. Sec. A 17 (6) 1943).

PRETTO, J. C. 1942 Estudios antropométricos en los escolares limeños. Bol. Inst. Psicoped. Nac. 1 (1): 47–54. (Biol. Abst. Sec. A 17 (6) 1943).

ROBINSON, W. D., AND J. H. JANNEY 1942 Studies of the physical characteristics of selected children in Madrid, Spain, in 1941. J. Pediat. 20: 723–739.

STEGGERDA, MORRIS, AND C. E. PETTY 1942 Body measurements on 100 Negro males from Tuskegee Institute. Res. Quart. Am. Assoc. Health, Phys. Educ. and Rec. 13: 275–279.

STUART, H. C., AND DANIEL KUHLMANN 1942 Studies of the physical characteristics of children in Marseilles, France, in 1941. J. Pediat. 20: 424–453.

Vickers, K. S. and H. C. Stuart 1943 Anthropometry in the pediatrician's office: Norms for selected body measurements based on studies of children of North European stock. J. Pediat. 22: 155–170.

Uttley, K. H. 1942 Heights and weights of Cantonese adult males. Trans. Roy. Soc. Trop. Med. and Hyg. 35 (4): 223–228. (Biol. Abst. Sec. B 16 (7) 1942).

Wise, F. C., and H. V. Meredith 1942 The physical growth of Alabama white girls attending WPA preschools. Child Develop. 13: 165–174.

Wolff, Georg, and Morris Steggerda 1943 Female-male index of body build in Negroes and Whites: An interpretation of anatomical sex differences. Hum. Biol. 15: 127–152.

Yerushalmy, J. 1942 The 1940 record of maternal and infant mortality in the United States. The Child, 6: 195–206.

Diet and growth, human and comparative

Bauer, C. D., and C. P. Berg 1943 Growth in mice fed diets rendered deficient in cystine, but not in methionine. J. Nutr. 25 (5): 497–502.

Berryman, G. H., and C. Chatfield 1943 A short method of calculating the nutritive value of diets. J. Nutr. 25 (1): 23–38.

Bessey, O. A., and R. L. White 1942 The ascorbic acid requirements of children. J. Nutr. 23 (2): 195–204.

Brockington, C. F. 1942 Effects of war-time nutrition on children. Pub. Health, 55, 175–178. (Nut. Abst. Rev. 12 (3) 1943).

Bronstein, L. P., S. Wexler, A. W. Brown and L. J. Halpern 1942 Obesity in childhood: psychologic studies. Am. J. Dis. Child. 63 (2): 238–251.

Bronstein, I. P., and L. J. Halpern 1942 Obesity in children. J. Pediat. 21: 485–496.

Brown, A. P., and F. Y. Moser 1942 Nutritional status indices for rural and urban Utah school children. Child Develop. 13: 101–112.

Bunkfeldt, R., and H. Steenbock 1943 The effect of dietary fat on bone calcification in the growing rat. J. Nutr. 25 (5): 479–490.

Butler, A. M. 1942 Nutritional requirements in infancy and childhood. Am. J. Dis. Child. 64 (5): 898–918. (Biol. Abst. Sec. B 17 (4) 1943).

Carlson, A. J. 1942 Food and fitness. Sci. Mo. 55 (5): 403–407.

Chen, J. 1942 Nutritional edema in childhood. Am. J. Dis. Child. 63 (3): 552–580.

Dann, W. J., and W. C. Davison 1942 Nutritional requirements of children: a resumé. Am. J. Dis. Child. 63 (2): 366–370.

Fanconi, G. 1942 Die Ernährung des gesunden und kranken Kindes im Kriege Schweiz. med. Wochenschr. 72, 958–962. (Nutr. Abst. Rev. 12 (3) 1943).

Fox, D. L., and W. R. Coe 1943 Biology of the California sea-mussel (Mytilus Californianus) II. Nutrition, metabolism, growth and calcium deposition. J. Exp. Zool. 93 (2): 205–250.

Grossman, Leo, and R. A. Benson 1942 The use of supplemental nourishment in the feeding of children: Height and weight studies on hospitalized and ambulant children. Arch. Pediat. 59: 799–804.

Hawks, J. E., M. M. Bray, S. M. Hartt, M. M. B. Whittemore and Marie Dye 1942 Potassium, sodium and chlorine balances of pre-school children receiving medium and high protein diets. J. Nutr. 24 (5): 437–448.

Holt, L. E. 1942 Dietary factors in physical growth. J. Pediat. 20: 260–265.

Johnson, R. E., R. C. Darling, W. H. Forbes, L. Brouha, E. Egaña and A. Graybiel 1942 The effects of a diet deficient in part of the vitamin B complex upon men doing manual labor. J. Nutr. 24 (6): 585–596.

Melnick, Daniel 1942 Vitamin B_1 (thiamine) requirement of man. J. Nutr. 24 (2): 139–152.

Milligan, E. H. M., and E. Lewis-Faning 1942 A study of the physical and nutritional condition of children in war time. Med. Officer, 67, 77–78, 85–87, 93–95, 101–102, 109–111, 117–118.

Pompeo do Amaral, F. 1942 Growth disorders in hypovitaminosis B_1. Rev. Gastro-enteral. São Paulo, 4: 209–234.

Robinson, W. D., J. H. Janney and F. Grande (Covian) 1942 An evaluation of the nutritional status of a population group in Madrid, Spain, during the summer of 1941. J. Nutr. 24 (6): 557–584.

Robinson, W. D., J. H. Janney and F. Grande 1942 Studies of the physical characteristics of selected children in Madrid, Spain, in 1941. J. Pediat. 20: 723–739.

Rohrer, A. B., and H. C. Sherman 1943 The bodily store of vitamin A as influenced by age and by food. J. Nutr. 25 (6): 605–610.

Simsarian, F. P., and P. A. McLendon 1942 Feeding behavior of an infant during the first 12 weeks of life on a self-demand schedule. J. Pediat. 20: 92–109.

Sober, H. A., G. J. Mannering, M. D. Cannon, C. A. Elvehjem and E. B. Hart 1942 Nutrition of the guinea pig. J. Nutr. 24 (6): 503–514.

Stewart, T. D. 1943 Food and physique. Ann. Am. Acad. Polit. & Soc. Sci. 225: 22–28.

Stuart, H. C. 1943 Need for observations of growth in appraising adequacy of nutrition in childhood. Am. J. Dis. Child. 65: 320–325.

Stuart, H. C., and D. Kuhlmann 1942 Studies of the physical characteristics of children in Marseilles, France, in 1941. J. Pediat. 20: 424–453.

Warkany, J., R. C. Nelson and E. Schraffenberger 1942 Congenital malformations induced in rats by maternal nutritional deficiency: II. Use of varied diets and of different strains of rats. Am. J. Dis. Child. 64 (5): 860–866.

Warkany, J., and R. C. Nelson 1942 Congenital malformations induced in rats by maternal nutritional deficiency. J. Nutr. 23 (4): 321–334.

Warkany, Josef, and R. C. Nelson 1942 Skeletal abnormalities in the offspring of rats reared on deficient diets. II. Histological studies. Arch. Path. 34 (2): 375–384. (Biol. Abst. Sec. B 17 (2) 1943).

Wegman, M. E., R. F. Marchante and Morton Kramer 1942 Infant mortality and infant feeding in Puerto Rico. Preliminary note. Puerto Rico J. Publ. Health and Trop. Med. 17 (3): 228–245. (Biol. Abst. Sec. B 17 (2) 1943).

WIERDA, J. L. 1942 Measurements and observations upon the intestine of rats fed unbalanced and supplemented diets. Am. J. Anat. 70 (3): 433–454.

WILLIAMS, R. D., H. L. MASON AND R. M. WILDER 1943 The minimum daily requirement of thiamine of man. J. Nutr. 25 (1): 71–98.

WILLOUGHBY, D. P. 1942 An extraordinary case of obesity and a review of some lesser cases. Hum. Biol. 14 (2): 166–177. (Biol. Abst. Sec. A 17 (4) 1943).

WOLPE, L. Z., AND P. C. SILVERSTONE 1942 A series of substitutes for milk in the treatment of allergies. J. Pediat. 21: 635–658.

Endocrines and growth, human and comparative

BATES, R. W., T. LAONES, E. C. MACDOWELL AND O. RIDDLE 1942 Growth in silver dwarf mice, with and without injections of anterior pituitary extracts. Endocrinol. 31 (1): 53–58.

BECKS, H., E. A. KIBRICK AND H. M. EVANS 1942 The bone histology of adult male rats thyro-parathyroidectomized when 1 month of age. J. Exp. Zool. 89 (2): 297–304.

BENDA, C. E. 1942 Endocrine aspects of mongolism. J. Clin. Endocrinol. 2 (12): 737–748. (Biol. Abst. Sec. B 17 (3) 1943).

BESSAU, G. 1942 Hormonale Therapie im Kindesalter. Deutsch. med. Wochenschr. 68 (15): 365–369. (Biol. Abst. Sec. B 17 (6) 1943).

BLUMENTHAL, H. T. 1942 Influence of weight (age) diet and dosage on response of thyroid and parathyroid glands of male guinea pig to potassium iodide; effect of this substance on adrenal gland. Endocrinol. 31 (2): 226–236.

BRONSTEIN, I. P., J. A. LUHAN AND W. B. MAVRELIS 1942 Sexual precocity associated with hyperplastic abnormality of the tuber cinereum. Am. J. Dis. Child. 64 (2): 211–220.

CINBERG, B. L. 1942 A manual of endocrine therapy. Brooklyn (Chemical Publ. Co.)

DEMPSEY, E. W., AND H. F. SEARLES 1943 Environmental modification of certain endocrine phenomena. Endocrinol. 32 (2): 119–128. (Biol. Abst. Sec. B 17 (5) 1943).

DOISEY, E. A. 1942 The estrogens. Endocrinol. 30 (6): 933–941.

DORFF, G. B. 1942 Gonadotropins and linear growth. The pituitary-gonadal mechanism and its relation to linear growth and sexual development. Am. J. Dis. Child. 64 (4): 661–673. (Biol. Abst. Sec. 17 (4) 1943).

———— 1942 The accelerated effects on growth during treatment for sexual underdevelopment. Arch. Pediat. 59: 791–798.

EVANS, H. M., M. E. SIMPSON, W. MARX AND E. KIBRICK 1943 Bioassay of the pituitary growth hormone: width of the proximal epiphyseal cartilage of the tibia in hypophysectomized rats. Endocrinol. 32 (1): 13–16.

FLEISCHMANN, W., H. B. SCHUMACKER AND W. L. STRAUS 1943 Influence of age on the effect of thyroidectomy on the Rhesus monkey. Endocrinol. 32 (3): 238–246.

GARDNER, W. U. 1942 Mammary growth in male mice fed desiccated thyroid. Endocrinol. 31, 124–127. (Nutr. Abst. Rev. 12 (3) 1943).

——— 1943 Influence of sex and sex hormones on the breaking strength of bones in mice. Endocrinol. 32 (2): 149–160.

GOLDBERG, M. B., AND H. LISSER 1942 Acromegaly: A consideration of its course and treatment. Report of 4 cases with autopsies. J. Clin. Endocrinol. 2 (8): 477–501. (Biol. Abst. Sec. B 17 (2) 1943).

GREGORY, P. W., S. W. MEAD AND W. M. REGAN 1942 A new type of recessive achondroplasia in cattle. J. Hered. 33 (9): 317–322.

GREULICH, W. W., R. I. DORFMAN, H. M. CATCHPOLE, C. I. SOLOMON AND C. S. CULOTTA 1942 Somatic and endocrine studies of puberal and adolescent boys. Monogr. Soc. Res. Child Develop. Vol. 7, No. 3, p. 85.

HERRINGTON, L. P., AND J. H. NELBACH 1942 Relation of gland weights to growth and aging processes in rats exposed to certain environmental conditions. Endocrinol. 30 (3): 375–386.

HETHERINGTON, A. W., AND S. W. RANSON 1942 Effect of early hypophysectomy on hypothalamic obesity. Endocrinol. 31 (1): 30–34.

HOOKER, C. W. 1942 Pubertal increase in responsiveness to androgen in the male rat. Endocrinol. 30 (1): 77–84.

HOOKER, C. W., AND C. A. PFEIFFER 1943 Effects of sex hormones upon body growth, skin, hair and sebaceous glands in the rat. Endocrinol. 32 (1): 69–76.

HUNTER, M. W., AND P. B. SAWIN 1942 The effects of thyroidectomy on the skull of the domestic rabbit. Am. J. Anat. 71 (3): 417–450.

HURXTHAL, L. M. 1943 Treatment of gigantism: Observations on a pituitary giant for six years. J. Clin. Endocrinol. 3 (1): 12–19. (Biol. Abst. Sec. B 17 (5) 1943).

KIBLER, H. H., A. J. BERGMAN AND C. W. TURNER 1942 Pituitary weight in growing New Zealand white rabbits in relation to live weight. Endocrinol. 31 (1): 59–62.

KOGER, M., V. HURST AND C. W. TURNER 1942 Relation of thyroid to growth. I. Effects of crystalline thyroxin upon rate of growth, food intake and body composition of female albino mice. Endocrinol. 31 (2): 237–244.

LANSON, H. D., J. B. GOLDEN AND E. L. SEVRINGHAUS 1942 Normal endocrine gland weights of female rats of the Sprague-Dawley strain throughout the growth period, and adult life. Endocrinol. 31 (1): 46–52.

LEÓN, L. A. 1942 Un caso de gigantismo en la raza India. Am. Indígena, 2 (4): 35–38.

MARKUS, M. B., S. D. GOOSMAN, N. H. EINHORN AND J. LERNER 1942 Facial development in hypopituitary dwarfism. Am. J. Orthodont. and Oral. Surg. 28: 334–350.

MEAD, S. W., P. W. GREGORY AND W. M. REGAN 1942 Proportionate dwarfism in Jersey cows. J. Hered. 33 (11): 411–416.

MIXNER, J. P., AND C. W. TURNER 1942 Pituitary weight of growing male albino rat related to body weight. Endocrinol. 31 (2): 261–263.

MIXNER, J. P., A. J. BERGMAN AND C. W. TURNER 1943 Relation of certain endocrine glands to body weight in growing and mature guinea pigs. Endocrinol. 32 (3): 298–304.

NEUFELD, A. H., AND J. B. COLLIP 1942 The primary action of the parathyroid hormone. Endocrinol. 30 (1): 135–141.

RAY, R. D., H. M. EVANS AND H. BECKS 1942 The effect of growth hormone injections on the costochondral junction of the rat rib. Anat. Rec. 82 (1): 67–76.

SCHOUR, ISAAC AND M. MASSLER 1943 Endocrines and dentistry. J. Am. Dent. Assoc. 30: 595–603, 763–773, 943–950.

SELYE, HANS 1943 Factors influencing development of scrotum. Anat. Rec. 85 (4): 377–386.

SIMMONS, KATHERINE, AND W. W. GREULICH 1943 Menarcheal age and the height, weight, and skeletal age of girls age 7–17 years. J. Pediat. 22: 518–548.

STERNBERG, W. H., AND V. JOSEPH 1942 Osteodystrophia fibrosa combined with precocious puberty and exophthalmic goiter: pathologic report of a case. Am. J. Dis. Child. 63 (4): 748–783.

SHELTON, E. K 1942 The clinical aspects of dwarfing. Endocrinol. 30 (6): 1000–1014.

TEPPERMAN, J., F. L. ENGEL AND G. N. H. LONG 1943 A review of cortical hypertrophy. Endocrinol. 32 (5): 373–402.

THOMPSON, W. D., N. J. HECKEL AND R. P. MORRIS 1942 Endocrine regulation of growth. (Abst.) Endocrinol. 30 (Suppl.): 1042.

WAGNER, R., P. WHITE AND I. K. BOGAN 1942 Diabetic dwarfism. Am. J. Dis. Child. 63 (4): 667–727.

WERNER, A. A. 1942 Endocrinology. Clinical application and treatment. (2d. rev. ed.) Philadelphia (Lea and Febiger). (Biol. Abst. Sec. B 16 (8) 1942).

Physiological and biochemical factors in growth

ANDERSON, N. A., E. W. BROWN AND R. A. LYON 1943 Causes of prematurity: III. Influence of race and sex on duration of gestation and weight at birth. Am. J. Dis. Child. 65: 523–534.

BEACH, E. F., D. M. TEAGUE, O. D. HOFFMAN, B. I. MUNKS, F. C. HUMMEL, H. H. WILLIAMS AND I. G. MACY 1942 The sulfur metabolism of children. J. Nut. 24, 257–271. (Nutr. Abst. Rev. 12 (3) 1943).

BENJAMIN, HELEN R., AND A. A. WEECH 1943 Basal heat production in relation to growth: A longitudinal study on normal infants six to twenty months of age. Am. J. Dis. Child. 65: 1–35.

BRUCH, HILDE, AND IRENE WATERS 1942 Benzedrine sulfate (Amphetamine) in the treatment of obese children and adolescents. J. Pediat. 20: 54–64.

CASSELLS, D. E., AND M. MORSE 1942 Blood volume and exercise. J. Pediat. 20: 352–364.

COMBS, G. F., L. C. NORRIS AND G. F. HEUSER 1942 The interrelationship of manganese, phosphatase and vitamin D in bone development. J. Nutr. 23 (2): 131–140.

Cunningham, Burris, and P. L. Kirk 1942 Measure of growth in tissue culture. J. Cell. and Comp. Physiol. 20 (3): 343–358.

Dutt-Chaudhuri, R., and K. C. Chaudhuri 1942 Gastric acidity in the new born. Indian J. Pediat. 9, 77–90. (Nutr. Abst. Rev. 12 (3) 1943).

Hamilton, H. L., and B. H. Willier 1942 Developmental physiology. Ann. Rev. Physiol. 4: 67–88.

Hawks, J. E., M. M. Bray, M. O. Wilde and M. Dye, (with V. H. Wiltgen and A. Kilpatrick) 1942 The interrelationship of calcium, phosphorus and nitrogen in the metabolism of pre-school children. J. Nutr. 24, 283–294. (Nutr. Abst. Rev. 12 (3) 1943).

Higgins, G. M., R. D. Williams and H. L. Mason 1943 Results of feeding rats a thiamine low diet of a type consumed by human beings. J. Nutr. 25 (3): 229–238.

Johnston, F. A., and L. J. Roberts 1942 The iron requirement of children of the early school age. J. Nutr. 23 (2): 181–194.

Kibler, H. H., and Samuel Brody 1942 Metabolism and growth rate of rats. J. Nutr. 24 (5): 461–468.

Lampen, J. O., G. P. Bahler and W. H. Peterson 1942 The occurrence of free and bound biotin. J. Nutr. 23 (1): 11–22.

Levine, S. Z., and H. H. Gordon 1942 Physiologic handicaps of the premature infant. I. Their pathogenesis; II. Clinical applications. Am. J. Dis. Child. 64 (2): 274–312.

Lewis, R. C., A. M. Duval, A. Iliff 1943 Basal metabolism of normal boys and girls from 2–12 years old, inclusive. Am. J. Dis. Child. 65: 834–844.

——— 1943 Basal metabolism of normal children from 13–15 years old, inclusive. Am. J. Dis. Child. 65: 845–857.

——— 1943 Standards for the basal metabolism of children from 2–15 years of age, inclusive. J. Ped. 23: 1–18.

McCrery, J., M. W. Lamb and N. D. Bavousett 1943 The basal metabolism of normal college women. J. Nutr. 25 (3): 245–254.

McKay, H., M. B. Patton, M. A. Ohlson, M. S. Pittman, R. M. Leverton, A. G. Marsh, G. Stearns and G. M. Cox 1942 Calcium, phosphorus and nitrogen metabolism of young college women. J. Nutr. 24 (4): 367–384.

Mills, C. A. 1942 Climatic effects on growth and development with particular reference to the effects of tropical residence. Am. Anthrop. 44: 1–13.

Shock, N. W. 1942 Standard values for basal oxygen consumption in adolescents. Am. J. Dis. Child. 64, 19–32. (Nutr. Abst. Rev. 12 (3) 1943).

Smith, H. H., S. McLanahan and W. C. Davidson 1942 An apparatus for determination of vital capacity in infants. Am. J. Dis. Child. 63 (1): 92–93.

Unna, Klaus, and G. V. Richards 1942 Relationship between pant thenic acid requirement and age in the rat. J. Nutr. 23 (6): 545–554.

West, H. D., and N. C. Jefferson 1942 The effect of aromatic hydrocarbons on growth. J. Nutr. 23 (5): 425–430.

Windle, W. F. 1943 Developmental physiology. Am. Rev. Physiol. 5: 63–78.

Effects of illness and disease on growth

AMATRUDA, C. S. 1942 Developmental neurology. J. Pediat. 20: 265–268.

BOYD, J. D. 1942 Round table discussion on diabetes. J. Pediat. 20: 782–795.

FISCHER, A. E., H. S. MACKLER AND H. H. MARKS 1942 Long term growth of diabetic children. Am. J. Dis. Child. 64 (3): 413–425. (Biol. Abst. Sec. B 17 (3) 1943).

MARTENS, E. J., AND H. V. MEREDITH 1942 Illness history and physical growth. I. Correlation in junior primary children followed from fall to spring. Am. J. Dis. Child. 64 (4): 618–630. (Biol. Abst. Sec. B 17 (4) 1943).

PHELPS, W. M. 1942 Maturity factors in neuro-orthopedic handicaps. J. Pediat. 20: 268–272.

URGUIJO, CARLOS A., AND MARIO WEISSMAN 1942 Study of the birth weights and ponderal growth of children of tuberculous mothers. J. Pediat. 21: 787–792.

WAGNER, RICHARD, PRISCILLA WHITE AND I. K. BOGAN 1942 Diabetic dwarfism. Am. J. Dis. Child. 63: 677–727.

Mental and behavioral development

ACKERSON, LUTON 1942 Children's behavior problems. A statistical study based upon 2,113 boys and 1,181 girls examined consecutively at the Illinois Institute for Juvenile Research. II. Relative importance and interrelations among traits. Chicago (Univ. Chicago Press).

AMATRUDA, C. S. 1942 Pneumoencephalography and the developmental diagnosis of behavior. J. Pediat. 27: 147–179.

BOYNTON, P. L., AND K. G. HERBERT 1942 Correlational analyses of the influence of basal chronological age on IQ relationships to specified anthropometric measurements. Hum. Biol. 14: 527–531.

CAMERON, N., AND H. F. HARLOW 1943 Physiological psychology. Ann. Rev. Physiol. 5: 453–478.

FORD, N., AND S. FRUMKIN 1942 Monozygosity in Mongoloid twins. Am. J. Dis. Child. 63 (5): 847–858.

LAMM, S. S. 1942 Physical expression of psychogenic disturbance in children. J. Pediat. 20: 236–243.

McGEEHEE, W., AND W. D. LEWIS 1942 The socio-economic status of the homes of mentally superior and retarded children and the occupational rank of their parents. J. Gen. Psychol. 60: 375–380.

MOSHINSKY, PEARL 1942 Social environment as a modifying factor in the correlation between maternal age and intelligence of offspring. Milbank Mem. Fund Quart. 20 (1): 47–60. (Biol. Abst. Sec. A 16 (8) 1942).

NAGGE, J. W. 1942 Psychology of the child: Mental and physical growth. New York (Roland Press Co.).

RICHTER, C. P. 1942 Physiological psychology. Ann. Rev. Physiol. 4: 561–574.

ROBBINS, S. D. 1942 Round table discussion on speech disorders. J. Pediat. 21: 408–427.

SANFORD, R. N., M. M. ADKINS, R. B. MILLER, E. A. COBB, ET AL. 1943 Physique, personality and scholarship: A cooperative study of school children. Monog., Soc. Res. Child. Develop. 8, no. 1, pp. 705 (25–58, 82–120, 511, 589–638).

SECUNDA, L., AND K. H. FINDLEY 1942 Electroencephalographic studies in children presenting behavior disorders. New England J. Med. 226 (21): 850–854. (Biol. Abst. Sec. B 17 (1) 1943).

Age — Changes

BERGMANN, LOUIS 1943 The blood vessels of human celiac ganglia and changes in their vascular pattern associated with age. Anat. Rec. 85 (2): 117–134.

COWDRY, E. V. (Edited by) 1942 Problems of ageing. Biological and medical aspects. 2d. ed. Baltimore (Williams and Wilkins). (Biol. Abst. Sec. B 17 (1) 1943).

FLAX, E., E. L. LEVERT AND R. A. STRONG 1942 A study of premature mortality. J. Pediat. 21: 717:726.

REED, L. J. (Edited, with an introduction by) 1942 Two papers on the degrees of mortality of mankind, by Edmund Halley. Baltimore (The Johns Hopkins Press).

SMITH, C. G. 1942 Age incidence of atrophy of olfactory nerves in man (a contribution to the study of the process of ageing). J. Comp. Neur. 77 (3): 589–596.

STIEGLITZ, E. J. 1942 Report of a survey on active studies in gerontology. Bethesda, Md. (Div. Chemoth., Nat. Inst. Health).

WOLFE, J. M., E. BURACK, W. LANSING AND A. W. WRIGHT 1942 The effects of advancing age on the connective tissue of the uterus, cervix and vagina of the rat. Am. J. Anat. 70 (1): 135–166.

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